A

SYSTEM

OF

PATHOLOGICAL & OPERATIVE SURGERY,

FOUNDED ON

ANATOMY:

ILLUSTRATED BY

DRAWINGS OF DISEASED STRUCTURE,

AND

PLANS OF OPERATION;

BY

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TO

GEORGE WOOD, Esq. Surgeon,

THIS VOLUME IS INSCRIBED

FROM GRATITUDE

FOR THE KINDLY INTEREST HE HAS TAKEN

IN THE

SUCCESS OF ITS AUTHOR;

BUT STILL MORE,

AS A TESTIMONY OF RESPECT

FOR

HIS PROFESSIONAL TALENTS AND

THE ZEALOUS,

LIBERAL SUPPORT, WHICH,

IN IMITATION OF THE CONDUCT OF

A MUCH RESPECTED

FATHER,

HE HAS UNIFORMLY GIVEN TO THE CULTIVATORS

OF SCIENCE.

ADVERTISEMENT.

The Author has to apologize to the Profession, and particularly to his Pupils, for the delay in the publication of this Volume. It unavoidably arose from the varied and fatiguing duties in which as a practical surgeon he was engaged. Since the appearance of the first Volume he has been elected one of the Surgeons to the Royal Infirmary of this city, an appointment which has extended his field of observation, and afforded him ample opportunities for promoting pathological inquiries. It will be perceived that he has availed himself of the advantages of this situation, and he trusts he will continue to do so in the farther prosecution of the work, so as to render it more worthy of the acceptance of the Profession than it might otherwise have been.

The Third Volume, which will complete the system, is in a state of great forwardness, and will be published as soon as the avocations of the Author will permit.

The Reader is requested to correct with the pen the following

ERRATA.

Page 30th, line 23, delete " most."
105th, —— 3, before " muscles" insert *extensor.*

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A

SYSTEM

OF

PATHOLOGICAL & OPERATIVE SURGERY.

CHAP. VII.

DISEASES AND ACCIDENTS OF THE BONES.

THE study of the healthy structure of the human body is of peculiar value to the operating surgeon, because the practicability and dangers of an operation can be determined only by an appeal to the original anatomy; while the study of diseased structure is more suited to the general practitioner, as it especially fits him for understanding the nature, and reflecting on the consequences of those changes which he is called on to remedy. We observe that a certain modification of vessels, or peculiarity of structure, in an organ, not only influences the function which it performs, but renders it more or less liable to

disease. Thus organs will inflame quicker or slower, and sustain various degrees of inflammatory action, according to their delicacy of structure and natural sensibility. A bone, for example, is not only longer of inflaming than the brain or eye, but will endure for days or weeks a degree of action which in a few hours would entirely destroy their structure. But although there is a manifest difference in the delicacy of the organs of the human body, as well as in the time requisite for disease to destroy them, the effects of inflammation are nearly the same in all; and if it be not subdued, it will terminate in a change of structure, with consequent loss of function, involving the general health sooner or later according to their relative importance in the system.

The bones, therefore, which appear in a state of health to be insensible, are, notwithstanding, from their vascularity and other living connections, liable to inflammation and all its consequences. When they do inflame, they manifest the same phenomena as the soft parts, such as redness, increased heat, pain and swelling; and, during the progress of the inflammation, they possess most acute sensibility. If we attend to the formation and structure of the bones, we shall find that they do not essentially differ from the soft parts. They are formed and regenerated in the same manner; they are liable to the same changes; they have, therefore, their natural periods of

growth and decay; and the inflammation to which they are liable has the same terminations. It terminates in resolution, as when a venereal node is dispersed by the use of mercury;—in adhesion, when diseased joints unite, as in anchylosis;—in suppuration, in the case of spina ventosa;—gangrene, in that of necrosis;—and ulceration, in caries.

GENERAL REMARKS ON THE STRUCTURE OF THE BONES.

While chemistry has demonstrated to us the component parts of the bones, and explained some important changes which take place in disease, minute anatomy has unfolded their vascularity, and shewn that through the medium of blood-vessels, absorbents and nerves, they are not only intimately connected with the other parts of the system, but, like them, are subject to perpetual change, accident, and disease. Chemical analysis has proved that more than one half of the bones is composed of earthy matter, and a great proportion of the remaining part gelatin or glue. The earthy matter is now ascertained to be chiefly the phosphate of lime. At one period both chemists and physiologists were ignorant of its nature. They perceived that it was analagous to calcareous earth, although it did not entirely correspond with it, or indeed with any other earth

with which they were acquainted, and they called it the earth of bones. Gahn, the Swedish chemist, first discovered that it consisted chiefly of phosphoric acid combined with lime.

To the phosphate of lime, or the earthy matter, the bones are indebted for their hardness, firmness, strength, and permanent form, while their vascularity and feeling in disease depend upon the gelatin or organized part. The earthy and the gelatinous parts always bear a certain proportion to each other in a state of health. If there be a superabundance of the phosphate of lime, the bones become brittle;—if, on the contrary, there be a deficiency of it, and consequent increased proportion of gelatin, they are flexible, and bend under the weight of the body. This flexibility is met with in youth, whilst, from the superabundance of earthy matter, brittleness prevails in old age. But either of these states may occur at any period of life from disease.

Bones are of different shapes. Some are flat, as the bones of the skull. These are composed of two tables, and intermediate cancelli. Others are long, as the shoulder-bone or thigh-bone. These have a canal for the marrow; are hard and firm in the middle, where they consist of dense osseous plates; but swell out at their extremities into broad surfaces, which are lighter than the shaft of the bone, and nearly wholly composed of reticula, or net-work. Others are small and irregular, like the patella, or the bones

of the tarsus. Such have only a thin bony plate, and are wholly composed of cancelli,—hence are very light in proportion to their size, easily fractured, and very subject to caries. The dense, or spongy structure of the bones materially influences the formation of callus. When a long bone is fractured in the middle, it is much sooner reunited than when broken towards its extremities; and when a bone is very spongy, and the patient in the decline of life, perfect callus is seldom formed.

In the fœtus the heads of the bone, or epiphyses, are joined to the shaft by means of an intervening cartilage, and can be easily separated by maceration. Before the union betwixt the epiphyses and body of the bone takes place, the head is sometimes separated in consequence of external injury. Thus the heads of the thigh-bone and shoulder-bone of a young subject have been separated by a fall, so as to resemble a fracture. But as the subject advances in years, the cartilage is gradually converted into bone; and in the adult state the head is firmly united to the shaft or body, so that no such accident can happen.

When we view the internal structure of a long bone, we perceive that it is chiefly composed of net-work or cancelli, which are in greater number at the extremities than near the centre of the bone. These cancelli contain the marrow, lodged in a number of little membranous bags,

which do not appear to communicate with each other, like the common cellular substance, but actually form distinct cells. They are plentifully supplied with little arteries, which secrete the marrow, supposed to be chiefly destined for the nourishment of the internal structure of the bone. The marrow is also contained in a smooth delicate membrane, which lines the canal of the bones, and which is termed the internal periosteum. Separation of this internal periosteum, or destruction of the vesicles containing the marrow, is generally followed by that of the internal structure of the bone.

The original cartilage in which the bone is formed is solid; but at the time the ossification commences the cancelli begin to appear; and this process is denoted by the entering into the cartilage of a red artery, which begins to branch in a diffuse manner. A bony nucleus is then formed, and the ossification extends from the centre throughout the whole bone. While the bony matter is deposited by the arteries, the absorbents carry away the cartilaginous substance; and this action of the arterial and absorbent system continues during life. The arteries are perpetually depositing bony matter, and the absorbents are as perpetually carrying it away. In health the deposition and absorption have always a certain relation to each other. If the absorption of the earthy matter be more rapid than the deposition, the bones lose their firmness, become flexible,

and bend in various directions, constituting the disease called Mollities Ossium. When, on the other hand, the deposition is more rapid than the absorption, the earthy matter is accumulated, and the bones become brittle, as in the disease called Fragilitas.

Bone, like every other part of the body, is formed by the arteries, the action of which, in secreting and depositing its substance, is incessant; for, while the absorbents are continually taking up the ossific matter, the arteries are continually depositing it; so that the bones of an animal are perpetually undergoing the same change as the soft parts. This fact may be easily proved. In a few days after giving madder with the food of an animal, the bones become tinged of a reddish colour; but when its use is left off, they shortly lose the tinge, and resume their natural appearance: Again, the bones are found yellow in those who have died of jaundice, while they have their natural colour in persons who have been cured of that disease: to which may be added, the formation of nodes and their reabsorption; the circumstance of the alveolar processes being carried away when the teeth fall out; and the disappearance of a carious or necrosed bone.

Now, that bone is not cartilage gradually hardened, is demonstrable, 1st, Because the parietal and other flat bones of the skull are covered by membranes, and do not pass through the

intermediate state of cartilage, the ossification shooting in a radiated form from a central nucleus through the membranes. 2dly, Because arteries and other parts which are not of a cartilaginous nature, have sometimes bone formed in them, a phenomenon that has taken place even in the substance of the brain. And, 3dly, Because the teeth are never cartilaginous, but are formed in membranous bags, which can be injected.

In the flat bones, as in the parietal and other bones of the cranium, the scapula and bones of the pelvis, bony fibres shoot in the process of ossification, like the radii of a circle, from the centre to the circumference; but in the long bones, as in the thigh-bone and shoulder-bone, they are disposed in parallel lines. Hence those of the latter are more numerous; and the bone is firmer in the middle than towards its extremities, where the fibres are more scattered.

The bones are insensible in their healthy state, but are, notwithstanding, profusely supplied with nerves, which enter together with the blood-vessels, as may be seen in the groove of the os humeri, the linea aspera of the thigh-bone, the back of the tibia, and in the jaw-bones. But though they do not ordinarily feel, yet when inflamed the pain in them is as acute as in the most vascular or highly organized parts of the system. It may be remarked, that the extremities of nerves only feel, and that while in a state of health, their sensibility is in the inverse

proportion of the pressure on their trunks. If there be no pressure, the feeling is distinct, and the sensation is immediately conveyed to the brain; if there is a slight degree of pressure, the sensibility is more obtuse, as when a limb is benumbed from compressing the trunk of the nerve which animates it; and, when a ligature is tied round it, the sensation is completely destroyed, and the limb is paralyzed. Now, if we suppose that the nerves of a bone have their trunks compressed, in proportion as the earthy matter is deposited in it and the bone itself becomes firmer in its texture, we have a satisfactory reason why this part of the animal structure stands so low in the scale of feeling.

That the bones possess absorbents also, is proved by the glands swelling in the upper part of a limb in spina ventosa, and in collections of matter in a joint; by the disappearance of the earthy particles, in the disease called Mollities Ossium, in which the bones are reduced to their former cartilaginous state; and by bones which have been tinged red from feeding animals with madder, losing that tinge, as has been already alluded to, a few days after the madder has been discontinued.

All the bones of the body, except the teeth, are covered with a membrane called Periosteum. This membrane is nothing but condensed cellular substance, and is composed of several layers, which are more compact and adhere more close-

ly together as they approach the bone. The periosteum is slightly attached in the fœtus, and can be easily separated, but adheres so firmly in the adult, that it is torn off with difficulty. It is itself very vascular, and is perforated by innumerable vessels which pass into the bone. The chief uses of this membrane are to afford insertion to muscles, to assist in the formation of bone,—particularly in its reproduction, when the original bone dies, as in necrosis,—and to serve as a conducting medium for vessels to pass into the bone to nourish it; for when the periosteum is torn off or destroyed, the bone dies or exfoliates.

From their connection with the periosteum, and from their internal organization, the bones are very vascular; and their vascularity can be as easily demonstrated as the vascularity of the stomach. We see the nutritious or medullary artery, as it is termed, entering nearly in the middle of the bone. As soon as it has entered the canal, it divides into two branches, one of which runs upwards to the upper, and the other downwards to the lower extremity of the bone. In their course both send off innumerable ramifications which supply its whole substance, and from the smallest of which is secreted the marrow. Other arteries enter the heads of the bone. Over its whole surface it is plentifully supplied with vessels, and these vessels are obscured only by the earthy particles; but if we inject a bone and expose it to the action of a mineral acid, the earthy particles

are removed, the bone is reduced to a cartilaginous state, and the whole mass appears highly vascular. The vascularity of a bone is also proved by hemorrhagy taking place from its surface when cut; and fractured bones are reunited, and cut bones healed, as completely as the soft parts.

In short, from all the observations that have been made upon the bones, it appears that they are not, as might at first sight be imagined, inanimate matter, but that they are endowed with a fabric of blood-vessels, absorbents, and nerves; that they possess a high degree of vitality, supported by an incessant action of vessels profusely supplied by the periosteum and adjoining structure; that in early youth they are flexible, but are daily becoming harder; that at eighteen or twenty years of age they are completely ossified, and the heads so firmly united with the shaft, as to be inseparable; that as we advance in life they become firmer, and hence in old age are harder and more easily fractured; that they are resolvable into plates in regular succession; and, that when they are destroyed by inflammation or caries, they are regenerated from the living vessels of the periosteum and adjoining bone. They also have this peculiarity, that in health they seem to be insensible, but when they become inflamed, or otherwise diseased, their sensibility is excited, and the pain is very violent. Their diseases are slow in their progress, difficult to

cure, and form a class at once the most distressing to the patient, and the most perplexing to the practitioner, of any that occur in the whole range of surgical pathology.*

SECTION I.

DISEASES OF THE BONES.

The bones, from their vascularity, are liable to inflammation like the soft parts, and many of their diseases originate from this cause. Some are induced, in consequence of increase of action, by which they swell into tumors; others by defect of action, by which the process of ossification is delayed, or altogether prevented; and a third class arises from the relative proportion of their earthy and gelatinous parts being destroyed, by which their structure is so far changed, that they either soften and bend in various directions, or acquire additional hardness, and are then more liable to fracture. Their most important diseases are *Caries, Necrosis, Exostosis, Rachitis, Mollities* or *Malacosteon,* and *Fragilitas.*

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* For many valuable observations on the structure and formation of the bones, see Monro's Osteology, and the 1st volume of the Anatomy by J. and C. Bell.

CARIES.

Caries is the ulceration of a bone which still retains its vitality. It is of the same nature as ulceration of the soft parts, and is always preceded by inflammation. The same increased vascular action which precedes ulceration of the soft parts, always precedes ulceration of the bones, and is denoted by swelling, more or less apparent as the bone is superficial or deep-seated; by pain; and by increased redness in the fabric of the bone, very conspicuous after injection. All the bones are liable to be affected with this disease, but it most frequently attacks the bones of the cranium, the vertebræ, the sternum, and ribs, and the tarsus and carpus. Caries must always be accounted a dangerous disease, except when situated in the centre of the long bones, where it is in general superficial and easily cured by exfoliation.—When the tarsus or carpus is affected, from the bones being grouped together, the disease is seldom confined to one of the bones, but extends through the whole. It is then incurable, and amputation is our only resource. When the vertebræ are affected by it, caries leads to distortion and paralysis of the lower limbs; and when the skull is attacked, this disease, unless issue be given to the matter by the trephine, or the removal of the carious portion of bone, terminates in inflam-

mation and ulceration of the brain and its membranes—compression—convulsions, and death.—Caries, therefore, appears to be a disease more or less dangerous according to the bones which are affected. It generally succeeds to inflammatory affections of the joints terminating in suppuration; hence in the morbus coxarius, or disease of the hip-joint, and in the latter stages of white swelling, the bones always become carious.

An ulcer with a carious bone in it seldom heals, and if it should cicatrize, it in a short time again breaks out. The caries acts as a foreign body, and the soft parts, from the irritation, inflame, suppurate, and ulcerate, exposing the diseased bone. The presence of caries may be readily determined by the discoloration of the superincumbent integuments; by the matter discharged tinging the probe of a yellow or black colour; by its fetid smell; by the granulations being white, or of a pale blue colour, and of a loose texture; and above all, by our being able to push the probe into the centre of the bone, as into a piece of sand-stone or rotten wood, without producing pain.

Caries is in general a disease of early life, because the bones at this period from their greater vascularity are more susceptible of inflammation—and because white swelling, which is always followed by caries in its advanced stages, is a scrophulous disease, and, like the other forms of scrophula, is peculiar to the young. Caries may

arise either from an internal or an external cause. That which arises from an internal is the most frequent; and in this case it is always more difficult of cure, than when it proceeds from external injury. Caries most commonly depends on the existence of scrophula—lues venerea—or scurvy. It may also arise from blows, from the bone being denuded of its periosteum and long exposed to the air, and from the pressure of tumors, or from any other cause which destroys the circulation in the part. Hence the ribs, sternum, and vertebræ, frequently become carious from the long continued pulsation of aneurism of the aorta.—This pressure produces caries in the same manner as gangrene in the soft parts is produced by obstructed circulation. Caries is also frequently the consequence of inflammation, and when a bone ulcerates or becomes carious, the diseased portion must be thrown off, like the slough of an ulcer, before the part can granulate or heal.

This disease, as already observed, is always more dangerous when it attacks the skull, the spine, the sternum, and the larger joints: because in these circumstances it soon affects parts which are most essential to life. When the sternum is affected, the spongy structure of the bone renders it particularly dangerous, as it does not exfoliate. Any of the bones may become carious from the existence of the scorbutic virus; but the bones most frequently affected are the tibia, and the alveolar processes of the jaws.

TREATMENT OF CARIES.

Caries depending on lues venerea or scurvy, as it is then a constitutional disease, must be combated by general remedies; when depending on lues venerea, by mercury; and when arising from scurvy, by vegetable diet, and particularly by the citric acid. If it originates in a scrophulous habit, the bones forming the joints are generally attacked; and, therefore, if the disease has made much progress it is always incurable, and recourse must be had to amputation. But in some cases, particularly in those of the hip-joint, and vertebræ, caustic issues have a powerful effect in checking the progress of caries, and, if applied when the bones are first attacked with inflammation, generally succeed in preventing the complaint. When the disease exists in the articulations it is also sometimes cured spontaneously by anchylosis.

The looser and more spongy the bone is in its structure, the more difficult the disease is to cure.

Hence when it attacks the epiphyses or extremities of the long bones, it is highly dangerous, and generally terminates in death, or requires amputation; whereas when it occurs in the centre of the long-bones, it is generally removed by the exfoliation of one or more of the bony lamellæ.

When the caries depends upon an external cause, and when the disease is slight, or does not

proceed to any great extent, it is always easily cured by the separation of the diseased from the sound parts. Caries is also more or less easily cured in proportion to the length of time the disease has existed, and to its extent. When it has been of long standing, it is more difficult to cure than when of a recent date; and when the superficial lamellæ only are affected, it is more easily cured than when the caries penetrates deep. When the external laminæ of the long bones are alone affected, exfoliation may be often procured by repeatedly perforating the diseased plates with the central pin of the trephine, or any sharp pointed instrument, so as to enter the sound portion of the bone, and produce an effusion of blood.—Here we act precisely on the same principle, as when we apply the red oxide of mercury and other stimulant applications to accelerate the separation of the slough in gangrenous ulcers. We excite inflammation and suppuration below, by which the dead is separated from the living bone, For the same purpose the actual cautery was much used by the ancients, and is still employed by the French surgeons.

When the soft parts are much inflamed, and there is considerable pain, they should be repeatedly fomented with warm solutions of opium.—But when this is not the case, and the disease is more confined to the bones, or when the inflammation is subdued, we should have recourse to saline fomentations. We foment the parts three

times a day, half an hour each time, with a warm saline solution, in the proportion of six drachms or an ounce of the muriate of soda, and two drachms of the muriate of ammonia to two pounds of water; and where circumstances will admit of it, after each fomentation, we apply to the diseased bone a bit of lint wet with some spirituous tincture, such as the tincture of myrrh, the tincture of myrrh and aloes, the tincture of bark or camphorated spirit of wine. The saline fomentations and spirituous tinctures have considerable efficacy in promoting exfoliation, or the absorption of the diseased bone. Its absorption will also be much accelerated by the occasional application of blisters to the neighbouring surface, and sometimes by the introduction of a caustic issue.

So long as there is not much constitutional irritation we may persevere in our efforts, by dressings, or otherwise, to remove carious bones; but when hectic fever supervenes, and the patient's health is evidently suffering, we must either have recourse to amputation, or attempt the entire removal of the diseased portion by the scalpel, chissels, trephines or saws. There were three cases successfully treated in this manner by Mr Hey of Leeds, and which are detailed in his "Practical Observations in Surgery."* There are also several remarkable cases of carious skull

* See Practical Observations in Surgery, by William Hey. 2d. edition.

narrated in the first volume of the Memoirs of the Royal Academy of Surgery, where large portions are said to have been removed by trephines, levators, and other instruments, and where the patients are reported to have recovered. In one of these mentioned by M. de la Peyronie, nearly the whole frontal bone was removed.

When the carious bone is situated in the extremities, and when the general health does not suffer much, we may allow a considerable time to elapse before we proceed to operation, trusting to general and local remedies, assisted by the efforts of nature, for the exfoliation or absorption of the diseased bone. But when the cranium or sternum is affected, we should at once have recourse to decided measures to remove the carious bone, and give exit to the pent-up matter; otherwise the brain or the parts contained within the chest will soon be involved in such disease that the patient cannot recover. When carious portions of the skull are removed, the pus flows freely out, and the surface of the dura mater is soon covered with granulations, which gradually become firm, and at length cicatrize. The sternum, as well as the cranium, may be freely trepanned, or the whole diseased portions removed by levators, saws, and other instruments. Galen raised and removed a large portion of a carious sternum in a young patient who recovered. Boyer raised, sawed off, and detached from a robust young man, more than the third of this bone, being the middle part, with

a considerable portion of three of the sternal cartilages of the left side, and thus exposed the basin of a large abscess. The left internal mammary artery was cut, but was easily secured by ligature. Granulations immediately sprang up on all sides, the ulcer readily cicatrized, and the parts remained sound. A similar operation was performed with complete success by M. Genouville, surgeon of the military hospital of Val-de Grace.* Whatever local measures may be pursued in the management of caries, the constitutional treatment should consist in the exhibition of tonic medicines, and generous diet, with wine.

Plate 4th, representing caries of the skull, is a good illustration of this disease.

NECROSIS.

As caries is the ulceration, necrosis is the gangrene or death of a bone; but the term is used by surgical writers, in a more extended acceptation, to imply a process in the animal economy by which the original bone dies and a new one is formed to supply its place. This disease is generally situated in the superficial and long bones, although the flat ones are by no means exempt

* Vid. Traité des Maladies Chirurgicales, et des Operations qui leur conviennent, par M. le Baron Boyer. Tom 3d.

from it; and when the disease does occur in the long bones, it is the diaphysis or shaft only that dies, the epiphysis or heads generally remaining unaffected.

Necrosis possesses one marked and wonderful peculiarity, by which it differs from every other instance of reproduction in the human body, namely, that the new bone is formed before the entire separation of the old, so that the use of the part is commonly preserved;—whereas in the regeneration of all other parts, the old is always destroyed before the new action of reproduction begins. While the shaft of the original bone is dying, a new bone is forming; and from the manner in which this process takes place, the new bone always surrounds and encases the old. From this circumstance it must naturally follow, that the new bone will be larger than the old; hence, when the process has terminated, and the cure is completed, the diseased limb is always thicker and more unseemly than the sound: but it remains of its former length, because the ends of the old bone retain their former connections; and the new bone that is deposited around the shaft of the old, connects its living extremities together, by a portion of new bone, equal in length to that which has been destroyed by the disease.

I have paid considerable attention to this disease in all its stages, and am convinced that the bone, so far as it is concerned in it, is merely passive. Necrosis is not preceded, as is generally

imagined, by inflammation and swelling of the bone; but the inflammation is confined entirely to the periosteum. In consequence of external injury in particular constitutions, or from a less obvious internal cause, the periosteum inflames and swells. This inflammation terminates in suppuration, which causes that membrane to separate from the bone. The nutritious artery, and the other vascular connections, are consequently destroyed; and the marrow and internal periosteum being insufficient to support its vitality, the bone dies. The death of the bone may also occur from a disease in the marrow. It then precedes the inflammation of the periosteum, and, by the irritation which it produces, is the exciting cause. Although the whole periosteum is liable to inflame and suppurate, it is generally the shaft only of the bone which dies; because the epiphyses or heads have a source of internal circulation, independently of the nutritious artery. They are more plentifully supplied with blood, and are less dependent on the marrow, than the diaphysis; but notwithstanding this circumstance, the heads of the bones are not necessarily exempted from this disease, as we frequently see the heads of the tibia, as well as those of the other long bones, attacked by it. When suppuration has taken place betwixt the periosteum and the bone, and the membrane is entirely detached, that portion of the bone which is dead, and which is termed the sequestra, now begins to separate from the living

extremities. The process of separation is precisely the same as that which takes place in gangrene of the soft parts; it is induced in a similar manner, and is denoted by the same marks. There first appears a red circle at that point where the living is connected with the dead bone; then a crack or ulceration; then a discharge of pus, or suppuration;—lastly, an effusion of coagulating lymph, followed by granulations. As soon as the bone is separated from the periosteum it begins to die. While it dies, but long before it parts from the sound epiphysis, the internal surface of the periosteum, which is now highly vascular, and in which there is considerable action, shoots out granulations that rapidly increase in number and size. These granulations are not soft like those of ulcers of the soft parts, but are firm and hard like the gum. They form an organized surface, which, by its absorbent powers, assists in removing the dead bone, and which soon begins to ossify. The ossification is first in distinct spots, but in a short time extends through the whole surface; and before the separation of the original bone, it is generally so complete as to form a firm osseous case, capable of affording the support that is requisite to preserve the functions of the part. While this surface is thus acting upon the dead bone, through the medium of the absorbents, the bone reacts upon it; and, by the irritation which it produces, excites ulceration in various points, so that openings are formed through which portions of the

dead bone are discharged. Granulations, which at last are also converted into bone, fill up the cavity of the new osseous case or shell, and remove the sequestra, either by forcing it out from its cavity, or by absorption. It is clear that when the sequestra is not discharged either by nature or art, it disappears by the action of the absorbents. It is not dissolved by the pus, for this fluid is known to possess no solvent power.

The experiments of Troja* shew that the destruction of the marrow will be followed by necrosis. He believed that the disease always arose from this cause, and not from any other. But it is certain that it has occurred when the marrow has been found healthy; which proves that it may also be induced by an injury done to the periosteum. There are three preparations of necrosis in the museum of the University of Edinburgh, in which the marrow is not only in a sound state, but its vessels are successfully and beautifully injected.† And a case is related by Pouteau, in La Medicine Eclairée,‡ where, upon the examination of a necrosed tibia, the marrow was found of a vermiel colour, and quite healthy. When necrosis arises from the destruction of the marrow, the dead bone, as has been already remark-

* Vide Troja de Novorum Ossium in intergris regeneratione experimenta. 8vo. Paris, 1775.

† See Monro's Outlines of Anatomy, vol. 1st.

‡ See La Medicine Eclairée, tom. 3d.

ed, acts as a source of irritation to the periosteum, which inflames, suppurates, and separates from it; and the same process is induced as when the disease originates in that membrane.*

The account which has now been given of the disease, explains the reason why the tendons of the muscles retain the same relative attachments in the new bone as in the old; and, if it be correct, it is evident that the periosteum must be the source from which the new bone is derived. This has been denied by some writers, who have assigned other origins of the bone; but since the various phenomena attendant on the disease have been more carefully traced, the opinion respecting it, now stated, is most generally received.

It is very difficult to assign a true cause for the origin of this curious disease. Necrosis may sometimes be traced to external violence, as a bruise or a blow. When this is the case, I have observed that it seldom immediately succeeds the external injury, but that a considerable period intervenes betwixt the apparent exciting cause and the first symptoms of the disease. It most frequently depends on constitutional causes, which authors in general ascribe to the scrophulous dia-

* For a satisfactory account of the progress of necrosis founded on pathological observation, see a letter to Mr Crowther from Mr M'Cartney, formerly lecturer on comparative anatomy at St. Bartholmew's hospital, and now professor of anatomy and surgery in the University of Dublin, contained in Crowther's Practical Observations on White Swelling.

thesis; and there is every reason to believe, that a blow would seldom or never produce it where there was no constitutional predisposition.

Necrosis is a disease of early life, chiefly occurring betwixt the 6th and 18th year. All the long and compact bones, as the os femoris, tibia, and fibula, humerus, radius, ulna and clavicle, but especially the tibia, are most subject to its attacks. The lower jaw and phalanges of the fingers are also frequently affected; and it is worthy of remark that when the lower jaw is attacked, the disease almost always occurs after the 30th year, and generally arises from external injury. The flat bones, as those of the cranium or scapula are more rarely affected than the long bones, and the disease is seldom seen in the short and spongy bones, as in the patella, or those of the tarsus and carpus. When the scapula or bones of the pelvis are attacked, the bone is regenerated; but when necrosis occurs in the bones of the cranium, or in those of the tarsus and carpus, it is never followed by the regeneration of new bone. Sometimes two bones are subjected to it at the same time, or, when the disease has made considerable progress, or even terminated in one bone, another is attacked. This is most frequently the case with the tibia.

In every case of necrosis there are inflammation and suppuration, as these phenomena must precede the formation of new bone. The patient first complains of violent pain all along the shaft

of the bone; and the pain rapidly increases and is attended with considerable tumefaction. At this period of the disease the integuments are not inflamed, but in a short time the internal inflammation terminates in suppuration, and the pus works its way to the surface. The skin then inflames. It at last ulcerates, and there is a profuse discharge of pus. In a short time ulcerations form in various parts of the skin, immediately over the seat of the disease; and these are always attended with granulations raised above the surface, and which have a healthy appearance. —The ulcerated papillæ communicate with sinuses through which the dead bone is most frequently discharged, either in small spicula along with the matter, or in larger pieces; and they never heal till the irritation ceases, either by the discharge or absorption of the old bone. The ulcerations continue fistulous, and are usually situated over the most superficial parts of the bone. The flow of matter in general is profuse, but in this stage of the disease no fluctuation can be felt, neither can the discharge be increased upon pressure, as the pus is contained within the newly-formed bone. There is no case of necrosis without these ulcerated papillæ; and when they do heal up soon, which sometimes happens, the cure is completed without the sequestra, or dead bone ever being seen. In this case there is no opening in the new bone or osseous shell. In necrosis there is always an accompanying fe-

ver, which is in proportion to the local symptoms; in the commencement and early stage of the disease, it is symptomatic or inflammatory fever; in the latter stage, it is the fever of irritation, or hectic fever.

The process in this disease proceeds sometimes rapidly, but most commonly is very tedious. In the former case the inflammation is severe; large ulcerations are formed; the dead bone quickly separates, and is thrown off in large pieces; and there is a temporary loss of motion. This occurs most frequently in the lower jaw. But in general the inflammatory symptoms are more gentle; the progress of the disease is slow; and the whole process is not completed for twelve months, or even two or three years. Here I may remark that the slower the process or more tedious the cure, the milder are the inflammation, and all the other concomitant symptoms throughout.

When the disease proceeds in this slow manner, the patient is little affected; the old bone is discharged with the matter, or is absorbed; the discharge gradually diminishes, and the ulcers heal up. After the discharge or removal of the old bone, the cavity of the new one, as formerly remarked, fills up with firm granulations. These are at last converted into osseous matter, leaving the new bone solid instead of hollow. But this solidity is not permanent, as by the action of the absorbents the bone again becomes hollow; and, in process of time there are formed a hollow tube

and cancelli similar to those which existed in the original bone. The new bone, from the manner in which it is formed, is very irregular on its outer surface. From this irregularity it does not seem to consist of lamellæ or plates; but, in every other respect, it possesses all the properties of bone, as it inflames, ulcerates, exfoliates, shoots out granulations, and forms callus when fractured.

Necrosis is a very tedious and painful disease, but it very seldom proves fatal. When the lower jaw, clavicle, phalanges of the fingers, or any of the smaller bones, are affected, it never terminates in death. When the os femoris or tibia is attacked, it does so very seldom; and when this occurs, it arises from the violence of the irritation and the profuseness of the discharge inducing hectic fever. When the disease is accompanied by violent symptoms, they most commonly present themselves upon the first attack of the inflammation, immediately after the commencement of the disease.

Plates 5th and 6th illustrate the most remarkable phenomena in necrosis.

TREATMENT OF NECROSIS.

Before the inflammatory symptoms indicating the existence of necrosis appear, there is every reason to believe, that in the majority of cases the bone is already dead; that the inflammation arises

from the irritation produced by it; and that its presence is necessary to the formation of new bone. If this be the case, it is absurd to talk of arresting the progress of the disease. The morbid phenomena denote a process of nature to throw off the dead bone and to form a new one. Our chief care should be to assist her in her operations; in the commencement to moderate the inflammation when too violent; and, in the subsequent stages, to promote the absorption of the dead bone, or, when it excites great irritation, to remove it by art, for the danger must always be in proportion to the constitutional irritation.

In the cure of this disease it is evident that there can be no fixed mode of treatment, as it must vary according to existing circumstances. When the inflammation is not very violent, when it soon terminates in suppuration, when the sequestra is either absorbed or discharged in small pieces with the matter, and when the patient is able to walk about, nothing is particularly required to be done, and the cure may be safely entrusted to nature. In this case, which most frequently occurs, the interference of art can only be productive of harm. But when the symptoms are violent, either in the commencement or progress of the disease, we must have recourse to those measures which appear best calculated to moderate them. In the commencement we apply leeches over the seat of the disease, and repeat them according to circumstances; while

we foment three or four times a-day, and half an hour each time, with opiate and saturnine solutions; and in the intervals apply to the affected parts large warm emollient poultices. We at the same time keep the patient cool and quiet, enjoin a low diet, and keep him open in his bowels. If there should exist much symptomatic fever, we may take blood from the arm to lessen the force of the circulation. This must be done in proportion to the age of the patient and the violence of the constitutional symptoms, but it is seldom necessary.

Soon after suppuration has taken place, the fluctuation is distinctly felt, and the skin inflames. In a short time the integuments ulcerate, and the pus is discharged. If the skin is long of ulcerating, the matter may be evacuated by touching it with a lancet. A succession of ulcerations soon proceeds along the course of the bone, the violence of the symptoms considerably abates, and in this stage of the disease there are numerous openings discharging pus, and communicating with sinuses which lead to the newly formed bone. The skin is discoloured, and the limb is thicker than the other, and more unshapely, from the circumstance of the new bone surrounding and encasing the old. —The great object of the surgeon at this time should be to promote the absorption of the sequestra or dead bone; and this end will be attained in a very marked manner by the repeated application of blisters over the seat of the disease, while

we keep up an irritation and discharge by means of savine cerate, or the common issue ointment. If this practice be had recourse to early, a cure will most generally be effected without the sequestra ever being seen; and the disease will not only be greatly shortened in its duration, but much mitigated in its violence.

If the sequestra should come through the newly formed bone and present itself externally, its separation may be greatly assisted by moving it daily backwards and forwards with the finger and thumb, or with a pair of dressing forceps. If it should be firmly wedged in and at the same time excite much constitutional irritation, we must remove it by the crown of the trephine, by googes and mallets, or by Mr. Hey's saws, having previously dissected back the soft parts, where the bone is most thinly covered, to the extent which is necessary. But I conceive that this practice of removing the sequestra by instruments ought not to be adopted unless there exists great constitutional irritation. The mere acceleration of the cure does not seem to me to justify this step, as the absorption of the dead bone may be more readily attained by repeated blistering and issues than is generally imagined. Where the sequestra cannot be removed, or where, notwithstanding its removal, the constitutional irritation continues to be so great as to endanger incurable hectic, the limb ought unquestionably to be amputated, lest by persevering too long in attempts to save it, we endanger the

life of the patient. But such a case is extremely rare. The ancients always amputated in necrosis, because they did not understand the nature of the disease; the moderns never have recourse to amputation, except when every other means prove inefficient to remove the hectic.

In delineating the progress of necrosis, we remarked that the new bone has in general acquired sufficient firmness to support the limb before the separation of the old, by which means the power of motion remains unimpaired. Where this is not the case, and the old bone separates before the new is sufficiently firm, there is a loss of motion as if the bone were fractured. In such circumstances the limb must be laid upon a large splint, and the accident treated like a compound fracture.

Although the management of the disease does sometimes prove troublesome, yet in the generality of cases, the powers of nature alone would effect a cure; and, upon the whole, necrosis may be said to be a disease rather tedious than dangerous.

EXOSTOSIS.

Exostosis is a tumor arising from the surface, or involving the internal structure of a bone, and seems to be of three kinds. The first may be denominated true exostosis, and is a swelling of the

bone itself, consisting of a hard, and apparently inorganized concretion. The second is less firm in its structure, and not of the same consistence throughout, being in some places bony, and in others cartilaginous or even fleshy; it is generally much larger than the hard exostosis; and the periosteum is in this case always thickened and diseased, adding to the bulk of the tumor. The third species of the disease partakes of the nature of both the first and second; but it is not so hard as the first, nor so soft as the second; it never attains to the size of either, but suppurates early, and the periosteum forms a considerable bulk of the tumor. This last species constitutes the true venereal node.

All the bones of the body are occasionally affected with exostosis; but, when free of pain, as is frequently the case, this disease demands no particular attention, unless when it proceeds to a great extent, or materially injures functions essential to life, as when it occurs in the bones of the cranium, pelvis, or vertebræ. Venereal exostoses or nodes are most generally observed in the hard and superficial bones, as those of the cranium, the lower jaw, the clavicle, and the tibia in the shin. The first and second species of exostosis are sometimes attended with acute pain, and sometimes give no pain whatever; when there is pain it increases as the tumor grows, and depends upon the stretching of the periosteum. But the third species or venereal node is

always extremely painful, especially when the patient becomes warm in bed. Exostoses, we have said, are not all of the same texture; some are close grained and hard like ivory; some are spongy, like the heads of the long bones; and others are hard exteriorly, and fleshy in the centre. Some contain pus or sanies, and others are firm throughout; some remain stationary and inert through life, and others suppurate. Exostosis in general has a particular tendency to terminate in caries, but the true or hard exostosis, which is of the consistence of ivory, never has that termination; it is seldom or never painful; does not acquire a great bulk; and, unless from its pressure on parts essential to life, is usually devoid of danger.

Exostosis sometimes arises from injury done to a bone, as by blows, ill-treated fractures, or from the bones being crushed; but more frequently it depends on venereal, scrophulous, and other constitutional affections. In some habits there is such a tendency to this disease, that all the bones of the body are more or less affected by it. When exostosis arises from a fracture or other injury, it is never of a compact structure, as when it originates from an internal cause, but is commonly partly bony, partly cartilaginous and full of irregular cavities, which frequently contain pus, or a thick gelatinous fluid. It has moreover a tendency to grow to an immense size, and seems particularly disposed to suppurate, and terminate in

caries. These bony tumors sometimes increase rapidly; but in general their growth is slow, and, like all other tumors, they augment in size with a rapidity proportioned to their bulk. Thus a tumor which has required three years to arrive at a certain magnitude, will in another year grow as large again; and, in six months more, will advance with such rapidity as to attain a size equal to what it has grown in the four preceding years.

The harder an exostosis is, the smaller is its size, the slower its growth; and it is accompanied with the less pain. The lower jaw seems particularly subject to exostosis. In the Memoirs of the Royal Academy for 1727, there is a case related by Morand, of an exostosis of the lower jaw occurring in a young girl. It arose in consequence of an accident which fractured the bone; gradually increased in size for twelve years; at last terminated in death; and was found to weigh thirteen ounces and a half,—while the whole jawbone of a subject of the same age, in a state of health, only weighed one ounce and a half. *

The skin situated over bony tumors is in general not discoloured, till it becomes involved in the diseased action, and the tumor is about to suppurate and terminate in caries. But this ob-

* See Memoires de L'Academie Royale de Sciences, 1727, and Bordenave's Memoire "Sur quelques Exostoses de la Machoire inferieure" in the 14th volume of the Memoires of the Royal Academy of Surgery, 12mo. edition.

servation does not a ways hold true; for sometimes it is red, or of a brownish or purple colour, even from the first, or shortly after the commencement of the disease.

TREATMENT OF EXOSTOSIS.

When exostosis depends on the presence of lues venerea, mercury is a specific remedy; but when it arises from other constitutional causes, it may be said to be incurable. When the disease does not produce pain, when the tumor is small, and when it is so situated as from its pressure not to injure any function necessary to life, it perhaps may be most prudent to interfere as little as possible, as we know but little of the nature of the complaint. But where it is painful, evidently increasing daily in size, and likely from its pressure ultimately to hurt important parts, every effort should be made to remove it or to check its progress. With a view to promote its absorption, blisters should be repeatedly applied to the tumor, and a discharge promoted by savine cerate or the weak blistering ointment. While we employ these local applications we may exhibit internally the muriatic acid. From a drachm to two drachms of this acid may be mixed with two pounds of cold water and drank at intervals in the course of the day. This medicine is observed to loosen the fabric of the bones, in con-

sequence of which the absorbents more rapidly carry off their earthy particles. All the mineral acids have this power more or less, but none possesses it in so marked a degree as the muriatic. It should, however, be administered with caution, as when imprudently used, it may produce a general softening of the bones, and induce a state analagous to mollities ossium. When these means fail of success, when the tumor is rapidly encreasing, and more especially when it deranges any important function by pressure, or otherwise, it may be justifiable to attempt to remove it, and in many instances this may be done with safety by means of metacarpal, flexible or chain saws, or with the saw invented by Mr. Machell of London. When the disease is so general that tumors exist in various parts of the body, and the constitutional remedies fail to remove them, it may be deemed a hopeless case. Sometimes the existence of the disease cannot be ascertained before death. Thus I have known an exostosis arising from the internal table of the skull, to compress the brain in such a manner as to produce palsy, coma, and death.

Plate 7th contains a representation of exostosis.

RACHITIS OR RICKETS.

Rickets, which is a disease marked chiefly by a deranged state of the glandular viscera of the

abdomen, impaired digestion, and imperfect ossification, may be considered a species of mollities ossium. It is peculiar to children; but it has sometimes, though rarely, been observed, that those who had laboured under it in their infancy, were afflicted in adult years with a general softening of the bones. There is a case related by Duverny of a man that had been rickety in his infancy, but who had entirely recovered by his twelfth year, having been attacked with mollities ossium of which he died; and there are similar cases on record, which seem to shew a great similarity betwixt the two diseases. The bones are soft in rickets, seem to have little of the phosphate of lime in their composition, and swell at their extremities: the epiphyses or heads are chiefly affected, and, by the bones yielding to the weight of the body and the action of the muscles, the victim of this disease becomes cruelly distorted.

Rickets is said to have first made its appearance about the middle of the sixteenth century in the western parts of England, from whence it spread rapidly throughout the north of Europe. It most generally attacks children betwixt the age of six months and two years after birth; and sometimes though rarely, after this period. From a state of apparent vigour and plumpness the child begins gradually to decline in health, and to lose his liveliness; the muscular parts diminish in firmness; the extremities and neck fall away, and become less fleshy; while the head enlarges, and

the belly tumifies. The fulness of the abdomen is always a prominent feature of the disease, and arises not only from the enlargement of the liver, spleen, and mesenteric glands, but from the intestines being much distended with flatus.

In the progress of the disease the skin loses its elasticity, and becomes of a dusky hue. The joints swell. The epiphyses of the bones become larger and softer; while their shafts or diaphyses, from their cartilaginous texture, curve in different directions, partly from pressure, and partly from the action of the muscles. From this last cause the bones are always bent to that side where the most powerful muscles are situated. The digestive organs are impaired; the flesh is loose; the whole fabric is relaxed; and from this state of health, the actions of the system become imperfect. The ossific process is delayed, or interrupted; and, from ossification not being perfected, the bones remain flexible. The distortion is most conspicuous in the spine and in the ribs; the capacity of the thorax is therefore much diminished; and from the constriction of the chest, conjoined with the pressure of the enlarged liver and spleen upon the diaphragm, there is always short and difficult respiration. To these symtoms are generally superadded difficult dentition, and an irregular state of bowels, most frequently tending to a diarrhœa consisting of fœtid and acid stools. There is imperfect digestion, and the breath has a sour smell. It is singular that this

disease should also be particularly characterized by a more early development than usual of the mental faculties. The enlargement of the head, with this advanced state of intellect, has been ascribed to the softness of the bones of the skull and the looseness of the sutures, permitting the brain to arrive sooner at maturity.

The sketch which I have now given, is that of the disease in its most aggravated form; but, for the last thirty years, at least in this country, rickets has been much milder in its nature, and less frequent in its occurrence. In those cases which have presented themselves, there have been an enlargement of the joints, a partial distortion of the limbs, a tumefaction of the belly, and an enlargement of the head. All these symptoms for the most part gradually disappear as the child grows up and acquires strength; although the distortion of the bones is apt to continue, and we always find the flat bones of the skull in those subjects who have been rickety in their infancy, considerably thicker than in those who have not laboured under this disease.

Rickets, the origin of which, like that of the other diseases of the bones, is involved in much obscurity, has been ascribed to scrophula, lues venerea, and even to difficult dentition. Scrophula and rickets indeed have many symptoms in common, as the tumefaction of the belly, the enlargement of the mesenteric glands, a softness and emaciation of the flesh;

and both diseases are apt to disappear of their own accord at the age of puberty, and are always more serious and more dangerous the earlier in life they occur.

A cold and moist atmosphere, filthiness, impure air, and meagre diet, conduce to produce rickets; hence the disease most frequently appears in manufacturing towns, and in the lower ranks of life. It seems also to depend much upon climate, as the disease has been observed to prevail more in Holland, Flanders, France and Great Britain, than in the other countries of Europe.

TREATMENT OF RICKETS.

For the cure of this disease we have no specific remedy, but most commonly trust to the general class of tonics, the most powerful of which are the preparations of iron, cold bathing and country air, with a light nourishing diet. Conjoined with these it has been recommended, with a view of hardening the bones, to give small doses of the phosphate of lime two or three times a day. Bonhomme, who particularly recommends this practice, was in the habit of administering to an infant ten grains of this substance, with as much of the phosphate of soda, three times a-day. I have generally given the phosphate of lime by itself to the extent of a scruple three or four times in the day, and I think with the most marked ad-

vantage. If the bowels are much affected with looseness, a few drops of laudanum and a little catechu may be occasionally combined with it. At the same time that we pursue this course, we prescribe a warm, dry, and pure atmosphere; and employ, evening and morning, general frictions with flannel or a flesh brush, or, what is preferable, with some stimulating liniment, as the camphorated spirit of wine, soap liniment, or the spirit of turpentine with palm oil, to which a little camphor may be added. Frictions with these liniments are much superior to dry frictions; and it would appear that their efficacy is increased in proportion as they raise a febrile action in the system. In the western islands of Scotland they cure rickets by the external application of oil procured from the liver of the skate. The wrists and ancles are well rubbed at bed-time so as to excite a fever of several hours duration; the same process is repeated every night till it ceases to produce fever; when this is the case the elbows and knees are rubbed along with the wrists and ancles, when the increased excitement renews it. After the friction of these parts ceases to produce the same effect, the spine and sides are also rubbed in conjunction with them, and the action is renewed. This process is continued every night as long as it produces fever, and when it ceases to have this effect, a flannel shirt dipped in the oil is put upon the patient which immediately produces it in a more violent degree than

was occasioned by any of the frictions; and this general application is persevered in till the cure is effected, which is generally in a short time.*

Whether we use medicines externally or internally, or whatever be the plan we pursue, we should at the same time attempt to correct any deformity, or to prevent its increase by machinery adapted to the distorted bones. The machinery should be altered as the parts regain their natural form, probably every fortnight or three weeks; if this is not attended to, the apparatus, however appropriate at first, may be productive of more harm than benefit, as it will ultimately come to press upon improper points, consequently prevent the bones recovering from the distortion, and so fix the deformity.

Mollities Ossium, or Malacosteon.

Malacosteon is a morbid softness of the bones, in consequence of which their texture is so far changed that they may be bent and twisted in all directions, and even cut like cartilage with the knife. This disease may depend either upon an inordinate absorption of their earthy particles, or upon a deficient secretion and deposition by the arteries. That the former of these is the case, is evident from the great quantity of earthy matter

* Vide Medical Comment. vol. 6. p. 95.

deposited from the urine of those patients who labour under the disease. Rickets and Mollities Ossium are diseases which bear a close resemblance to each other; and indeed they are so far the same, that in both there is a deficiency of the phosphate of lime or earthy matter in the bones; but they differ in this, that in Rickets ossification has never taken place, or the earthy matter has never been deposited; whereas in Mollities Ossium the structure is broken down after it has been completed, and the earthy matter is carried away by the increased activity of the absorbents. From this statement it appears that Mollities Ossium is a disease peculiar to the adult, while Rickets can occur only in infancy.

In Malacosteon the disease is sometimes confined to one or two bones, and sometimes all the bones of the body are more or less affected by it. In the former case, I have most frequently seen it situated in the spine. But although Mollities Ossium often occurs as a partial disease, as a general disease it is extremely rare, and seems to depend upon causes with which we are not yet well acquainted. The most remarkable examples on record of a general affection of this nature, are the following:—The case of Ann Elizabeth Queriot, related by Dr Hosty in the 48th volume of the Philosophical Transactions. This poor woman was attacked at the age of 36 years, after the birth of her first child. The disease was attended with violent pains in the bones, fever, great

heat, profuse perspirations, and the deposition of a white sediment in the urine. The bones became so soft, that they bent in various directions, and produced such distortion, that her lower extremities turned gradually upwards, so as to lie in a line parallel with her body. This disease lasted about two years; and after death she was found considerably shortened in stature. All the bones were so soft that they could be cut with a knife; and, instead of marrow, their cavities were filled with a reddish matter like coagulated blood. They were so flexible that the extremities had assumed a curved direction; and they could be laid straight, but they soon resumed their former curve. No cause could be assigned for this disease, and during its progress she was three times pregnant. The next remarkable case is that of Madam Supiot, detailed by Morand in the Memoirs of the Royal Academy of Sciences, for 1752. She complained of violent pain over the whole body; general weakness, with great heat; and there was a white sediment in the urine. These symptoms were soon followed by a general softening of the bones, and a distortion so complete that the legs were turned upwards, and her feet lay on each side of her head. There was also great apitude for conception, as she was pregnant three times during the course of the disease, which lasted about five years. After death all the bones were found soft and flexible, and much distorted, with considerable shortening of stature. It was observed that Ma-

dam Supiot, for sometime before she was attacked with her complaint, was much addicted to the eating of kitchen salt. She usually eat a pound and a half a-week, without any vehicle; this practice she continued for two years; and her disease has been ascribed to this habit.

The third case is that narrated by Mr. Gooch, in the first volume of his Surgery. His patient was a female, who broke her leg in walking across the room; and although it was set and bandaged up, it did not unite, but the bones of that leg began to grow soft. This change was soon followed by a similar affection of the bones of the opposite leg and thigh; then the disease extended to the spine, which became distorted; at last it became more general, and from being unable to walk, she was confined entirely to bed. She lost two feet two inches of her stature; and after death all the bones, except the teeth, were found so soft, that they could be cut with a knife. The flexibility of the bones was preceded by pain over the whole body, and in its progress was attended with fever. The next case worthy of notice is that of a Mrs Foster, recorded in the 5th volume of the Medical Observations and Enquiries. She first complained of a pain in the bones, which began in her ancles, then extended to her legs, thighs, haunches, back and neck, and at last to the whole body; then she began to stoop, and was obliged to walk about with a stick. She was delivered of [illegible]n by dreadful labours. Her bones

at last became so completely soft, that all power of motion was lost; and, after ten years suffering, she expired after the Cæsarian operation, greatly shortened in stature. It was remarked, that she also had been accustomed to eat much kitchen salt. The last remarkable case is also contained in the 5th volume of the Medical Observations and Enquiries. It is that of a James Stevenson, a shoemaker, 35 years of age. He had for two years experienced violent pains in his feet and knees, with frequent headaches; at the end of the second year he fell down in his shop, and imagined that he had sprained his thigh. After this accident he could not walk without the help of a crutch and a person's arm. About a month from this, when he was going up stairs, leaning on his wife's arm, he kicked his toe against a step, fell down, and called out that his thigh-bone was broken. The bone was reduced and set. After some time, the surgeon, wishing to examine the state of the limb, undid the bandage, and made the man's wife place her hand under the ham, and take hold of the leg below the knee:—to his astonishment the thigh-bone broke again immediately above the knee; and turning round to give the wife some directions, he saw the leg doubled in her hand, having broken again in the tibia and fibula with but little pain. All his bones became soft and distorted, particularly those of the lower extremities. The patient lost considerably in stature; and for the

first two years of his complaint, his urine deposited a white sediment, which, when evaporated, became like mortar.—He languished six years in bed, and died in 1785.

There are several circumstances in which these cases agree. In all there were long continued pains previous to the softening of the bones.—These pains were particularly distressing upon motion, and soon increased so much in violence, and were attended with so great a weakness, as to render motion impossible. The next remarkable symptom in which they coincide was the deposition of a white sediment from the urine.—This sediment, it is worthy of remark, always corresponded in quantity with the bending of the bones, and upon being analysed was found to be the phosphate of lime. In these cases, shortly after the sediment in the urine was observed, it was noticed that the bones began to soften, to bend in various directions, and to produce remarkable distortion. This naturally occurred from the action of the muscles, and from the superincumbent weight of the body. These cases also show that the disease is in general slow in its progress, and that sometimes, as soon as the bones become soft, they lose their cohesion, and are fractured upon the least exertion, or in consequence of the slightest accident, as happened in Mr Gooch's case, and in that of James Stevenson. From the constriction of the chest in mollities ossium there is always difficult respiration; and, from the ge-

neral distortion, all the functions are impeded, and the patient dies hectic.

TREATMENT OF MOLLITIES OSSIUM.

There is but little known of the nature of malacosteon. When the disease has been general, it has always proved fatal; when partial, it has been cured. No plan has been pointed out, or remedy prescribed, in which we can place any confidence. We therefore generally trust to the preparations of iron, the cold bath, and other tonics, with frictions, and a diet consisting chiefly of animal food. When the disease is partial, as when situated in the spine or lower extremities, much benefit is derived from well constructed machinery, which gives a temporary support, and prevents distortion. But when the disease is general, the application of machinery is inadmissible. While we pursue a general tonic plan, we may, as in rickets, administer from a scruple to half a drachm of the phosphate of lime, three or four times a-day. But though I have frequently prescribed this medicine, I cannot say that it has been followed by any very manifest advantage.

Plate 8th is a good illustration of this disease.

FRAGILITAS, OR FRAGILITY.

The fragility of the bones is a state opposed to mollities ossium, or rickets. It depends on a superabundance of earthy particles in their composition; or arises from a deficiency of their gelatinous or organized part. It is peculiar to adults, and occurs very frequently in old people. The bones, besides being more easily fractured in old age, and much more difficult to reunite, frequently become brittle from long continued and repeated salivations; and in the advanced stages of cancer, scurvy, and syphilis, it is no uncommon occurrence for one or more of the bones to fracture upon a slight exertion. In cancer, I have known the os humeri to break without any external injury; and in syphilis I have seen the thigh-bone fractured merely by the man turning himself in bed.

This state of the bones is always symptomatic of some other disease, except in old age, where it is a necessary consequence of the change which takes place in their structure; but it then never prevails to the same degree, as in the cases we have mentioned.

TREATMENT OF FRAGILITY.

When the bones become so fragile in the decline of life as to be fractured without any apparent violence, the fracture never unites, and the disease is incurable; which is also the case in the advanced stages of cancer. But when fragility presents itself, as a consequence of scurvy or syphilis, it must be combated by the remedies which cure these diseases, although I believe it will generally be found to be incurable.

EXCISION OF DISEASED PORTIONS OF BONE.

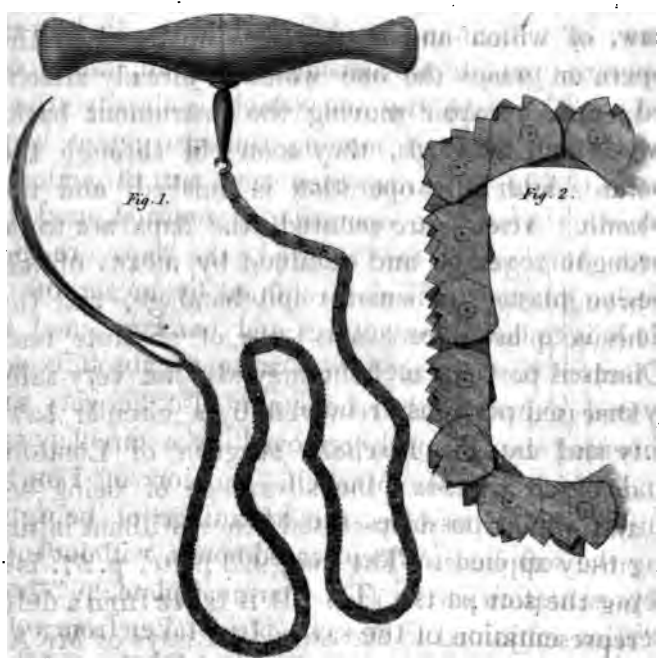
Paulus Æginettæ, and others of the ancients, recommend the removal of diseased portions of bone, particularly of carious joints; but the operation in the latter case has been performed among the moderns chiefly by Moreau, the father and son, Sabbatier, and Messrs. White and Park. Surgeons are in the daily practice of removing protruding portions of bone in compound fracture, and a cure is thus frequently obtained without shortening of the limb. We often saw off the ends of the bone, in the case of a false joint following fracture; and by this practice sometimes obtain a perfect consolidation by the formation of callus. In 1760, Le Cat sawed out three inches and ten

lines of the os humeri of a soldier; and by means of machinery, kept the limb of its former length. The deficient portion of bone was regenerated, and the man recovered, with the perfect use of his arm. Large portions of carious bone have been removed by Mr Hey of Leeds, and the use of the limb has been preserved. Even a portion of the lower jaw has been cut out with success by that bold and dexterous operator Dupuytren. We know, from our experience in fracture and necrosis, how easily bone is regenerated; and certainly cases frequently occur where we may not only with safety, but with certain success, cut out diseased portions of bone. The practice is particularly applicable to caries and exostosis, where the disease is local, and does not prevail to any great extent. But while I consider this practice safe and beneficial, when applied to diseased portions of the shaft of a bone, I cannot but think it highly dangerous when practised on the joints; and it is to diseased portions of the diaphysis of a bone that I would chiefly confine the operation. It appears to me that there can hardly be a motive for cutting out the bones in a diseased joint. No prudent surgeon would attempt such an operation, as long as the local disease did not affect the constitution; and when this is not the case, our daily practice teaches us, that by subduing the inflammation by means of local blood-letting and warm fomentations, conjoined with rest, the ends of the bones

in joints which are completely carious, will frequently anchylose, and the use of the limb be preserved. Again, where the discharge and irritation are so great as to affect the general health, and render some operation necessary, the simple one of amputation of the limb is decidedly preferable to the tedious operation of cutting out the diseased bones. Amputation is speedily performed, the local irritation is at once removed, and, the hectic subsiding in a few hours, the constitution is freed from the low febrile action, and the parts in general immediately adhere; whereas when the carious bones in a joint are cut out, the incisions are required to be extensive, the operation is difficult and tedious, the suppuration in general profuse, and the patient long of recovering. If the operation of excision of the joints were uniformly resorted to in a disordered and enfeebled state of the system, I will venture to assert, that in nineteen times out of twenty the patient would die; and in this assertion I think I shall be supported by every practical surgeon.

In the resection of diseased portions of bone, there are four things which should be chiefly attended to. 1st, To cut no more of the soft parts than what is absolutely necessary, as the supervening inflammation, suppuration, and other dangers, are generally in proportion to the extent of wound. 2dly, To make the incisions upon that side of the bone which is least covered by soft parts, and at a distance from the great vessels.

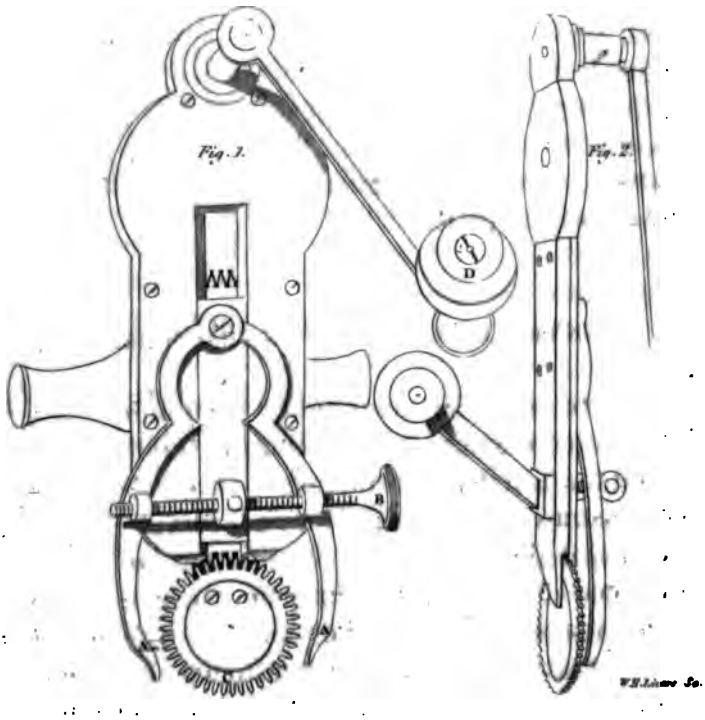
3dly, To protect the principal arteries and nerves of the limb, as the wounding of the former would give rise to troublesome or fatal hemorrhage, and of the latter to paralysis. And 4thly, After the removal of the diseased bone, to attempt to procure immediate reunion, by bringing the edges of the wound together, and retaining them so by adhesive-plaster and bandage. The safety of the principal vessels and nerves may be ensured by inserting betwixt them and the bone a plate of steel or a piece of pasteboard; or the operation may be more effectually accomplished, and the whole process in every shape rendered easier and safer, by em-



ploying the chain-saw invented by Dr Jeffrey, Professor of Anatomy in the University of Glasgow, and delineated in the marginal plate, p. 55. This saw is constructed with joints like the chain of a watch. Fig. 1. is a representation of it reduced to nearly half its size; fig. 2. a side view of a portion of the saw, magnified in order to shew the manner in which it is constructed.—An incision is made in the course of the bone, where it is most superficial and sufficiently distant from the artery; the flesh is then to be separated from the bone; after which the saw is easily passed by means of a blunt curved needle or aneurismal-hook. A handle is hooked on the saw, of which an assistant lays hold, while the operator grasps the one which is already attached; and, by their moving the instrument backwards and forwards, they soon cut through the bone. After the operation is finished, and the bleeding vessels are secured, the flaps are to be brought together and retained by means of adhesive plaster, or sutures and bandage, and the limb is to be placed in a state of absolute rest. Diseased portions of bone may also be very safely and expeditiously removed by a circular saw, invented by Mr Machell, surgeon of London, and which possesses the advantage of being securely applied to deep-seated bones, without injuring the soft parts. The marginal plate, p. 57. is a representation of the saw. It is taken from a delineation subjoined to the Surgical Essays of Mr A.

Cooper, by whom it has been much used, and who particularly recommends it.

Fig. 1st, a front view of Machell's saw; AA, forceps on its sides, by which the bone is held; B, a screw which regulates the forceps; C, the circular saw; D, a winch which turns the saw by concealed wheels. Fig. 2, a lateral view to shew the position of the handle.



SECTION II.

ACCIDENTS OF THE BONES.

THE chief accident to which the bones are liable is fracture. The injury may be confined entirely to the bone, as in simple fracture; or there may be a complication of injuries involving the soft parts to a greater or less extent, as in compound fracture. The former accident occurs so frequently, that its management forms the daily occupation of the surgeon. The second is attended with so much danger as sometimes to hazard the life of the patient.

GENERAL OBSERVATIONS ON FRACTURES.

A fracture is a solution of continuity in a bone, in consequence of peculiar external injury, or the too forcible contraction of the muscles.—To illustrate this definition, it is necessary to observe, that the solution of continuity must not be produced by a sharp instrument, which would occasion a wound of a bone, and not a fracture; and that although it has been customary to ascribe fracture solely to external violence, it is manifest that the definition should also embrace the powerful action of the muscles, as bones are, even in a

healthy state, frequently broken by muscular strength alone, and where no external injury has been inflicted. Thus the patella is most commonly fractured, not by a blow, but by the power of its own muscles in an endeavour to recover a false step; and the action of the muscles in boxing has fractured the shoulder-bone.

The chief signs of fracture are pain and inability of motion, distortion, and crepitus upon moving the injured bone. The three first of these signs are equivocal, and the last decisive. Thus the two first, pain and inability of motion, may occur in consequence of luxation, or even be produced by contusion. Distortion, too, accompanies luxation as well as fracture; while crepitus, on the other hand, although it does not always present itself, is never produced by any other cause. The pain is in proportion to the displacement of the bones, and is always increased upon attempt at motion; while the inability to move the limb depends upon the nature of the bone fractured and the extent of the injury. Distortion does not always occur, but presents itself only when the fracture is oblique, or when the fractured bone is surrounded by many and powerful muscles; and it arises partly from the weight of the limb, but still more from the action of the muscles; and is therefore greater in the leg and thigh, than in any other part of the body. Crepitus invariably takes place upon motion if the bones are not displaced, but, when they are displaced, it does not occur.

The bones can be felt grating, only when their fractured extremities are brought in contact; and hence, in fracture of the neck of the thigh-bone, although we move the limb, we feel no crepitus, till such time as by extension we have brought the fractured ends in contact. We can also frequently by the touch detect the existence of a fracture, especially where the bone is superficially covered by soft parts, as by running the fingers along the clavicle or spine of the tibia, when the injury is situated there.

But notwithstanding the signs enumerated by authors, it is sometimes difficult to detect the existence of fracture. This is more apt to be the case, when the bone is deep-seated; when there is much swelling from ecchymosis, which in a certain degree accompanies all fractures; when secondary swelling and tension have taken place from inflammation, before the surgeon is called; and when the fracture is situated in one of the bones of the leg or fore-arm, more especially in the fibula. In this last case the tibia acts as a splint, and keeps the leg of its proper length; and, if the fracture be two or three inches above the ancle, the patient is even able to walk. I have observed this in several instances,—particularly in a boatswain of a line-of-battle ship, whose fibula was fractured by a blow from a large shot thrown at him in the dark; in the case of a gentleman who had this bone broken in consequence of his horse falling; and in that of a female, who frac-

tured the fibula by falling from the top of a chest of drawers, in attempting to take something down from a cupboard. In all these cases the patients were able to walk about, till such time as the irritation produced violent pain, inflammation, and swelling.

When a bone is broken, and there is no corresponding wound of the soft parts, the fracture is denominated a simple fracture. When the broken bone is complicated with a corresponding wound of the integuments, produced by the potrusion of one or both ends of the fractured bone, it is called a compound fracture. The term compound has also been applied to those fractures where the bones have been much shattered, although there was no wound of the skin, but in this sense the term is now seldom or never used, being restricted to those cases where there is a corresponding wound of the integuments.—A fracture is said to be transverse, when the bone is broken right across; and again it is called oblique, when the bone is shattered or broken, not across, but in an oblique or slanting direction.—The tranverse fracture occurs most frequently in the shoulder bone, from its straight direction; and the oblique in the thigh bone, from its oblique position, and the direction in which the force is most commonly applied. The fracture in this last case is always recognized by the shortening of the limb; by its sudden retraction after the extension is removed; and by the difficulty of keep-

ing the ends of the bone in contact. In the plate annexed both these species of fracture are delineated. A, represents the transverse fracture situated immediately above the condyles of the thigh-bone, in which situation the fracture is always of this description, in consequence of the direct line in which the lower part of the bone is placed. B, represents the oblique fracture in the upper part of the bone, induced by the oblique position of this portion of it.

W.H.Lowe Sc.

GENERAL TREATMENT OF SIMPLE FRACTURES.

The moderns have arrived at great simplicity in the treatment of fractures, and have laid aside the torturing machines of Parè, Scultetus and Hildanus. Instead of extending the limb with great violence, retaining the ends of the bones in contact by complicated machinery, and binding up tightly with a roller, we relax the muscles, which allows us not only to place the ends of the fractured bones in contact, but to retain them in that situation till they are re-united; we then secure the limb with two long splints and circular tapes, and entrust the cure to nature. We have interdicted all tight bandaging, which not only produces excruciating pain, but also excites the spasmodic action of the muscles, inflames, swells the limb, and is apt to induce gangrene. We have more especially laid aside the circular roller, which cannot be undone without discomposing the fracture; and when we have recourse to bandaging at all, it is the eighteen-tailed bandage, or simple tapes, that we employ; which permits us from time to time freely to examine the nature of the injury, without moving or deranging the fractured bone.

The older surgeons, in reducing fractures, powerfully extended the limb, pulling at its lower part by means of hand-towels, lacs, and numerous

assistants; while resistance was made at its upper part in a similar manner by other assistants,—the surgeon all the time struggling to reduce the fracture. This process was termed Extension and Counter-extension. When the surgeon had succeeded by this means in bringing the fractured extremities of the bone into contact, he squeezed them with his hands, and forced them into their natural situation,—which was called Coaptation. He next applied two hard splints, which only extended a little way beyond the fractured ends of the bone; and lastly, a bandage, which was generally a circular roller, with which the leg was bound firmly up,—and this part of the process was termed Deligation. The older surgeons imagined that when a bone was fractured, the upper end rose; and this being their doctrine, they always applied a compress and firm roller upon the prominent or projecting point of bone, in order to keep it down. After the fracture was reduced, the patient was laid upon his back, and the limb was placed in an extended posture.

In the works of Parè, Scultetus, Hildanus, and Heister, are delineated different kinds of machinery for the reduction and retention of fractures, These afford a dreadful proof of the rude and violent methods then adopted, and sufficiently account for the spasms, convulsions, inflammations, swellings, and mortifications, which prevailed so frequently in the practice of the older surgeons, as is manifested by their writings.

The attempt at reduction, while the limb was extended, required great force, because the muscles, which are the only opposing powers, were then on the stretch, and thus formed a great obstacle to its accomplishment. The short hard splints, by extending so little way, had no command over the extremities of the fractured bone, and could not retain it in its proper position; while the application of a circular roller required the limb to be raised, so that the fracture was moved at every turn. This raising and moving of the limb, the tightness of the roller, and the pressure of the small hard splints, chiefly upon the fractured extremities of the bone, excited inflammation and swelling, and greatly increased the danger. Besides, by not retaining the fractured bone, either the limb was distorted every time the patient moved in bed; or, to prevent this, the bandage was made so tight that it could not be suffered, and it was therefore alternately slackened and tightened every few days, by which the limb was very liable to be injured. By pressing down the projecting point of bone with a compress and roller, they in many cases forced it through the skin; and by placing the patient on his back, with the limb in an extended posture, instead of relaxing the muscles they put them on the stretch, which was the most uneasy posture for the patient, as well as the most unfavourable for the fractured limb.*

* In the reduction of fractures the French surgical writers direct the extending and counter-extending powers to be appli-

The practice now described was implicitly followed, down to the time of Mr Pott, to whom we are chiefly indebted for teaching us to relax the muscles, and thus pointing out the best position for a fractured limb. But many important improvements have been made in this department of surgery since his day, particularly in substituting circular tapes for bandages, and in some cases laying aside bandages altogether.

In the treatment of simple fractures, we shall find that upon bending the limb and relaxing the muscles, the fractured bones can in general be very easily replaced. This is always easily done where the fracture is not oblique, or where it is not in a situation to be affected by powerful muscles, as

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ed not in the extremities of the fractured bone, but to the bones in connection with it, and the generality of French surgeons adopt this rule. Thus in the reduction of the thigh-bone, the extension is made by pulling the leg, and the counter-extension by fixing the pelvis; and in setting the bones of the leg, they extend by pulling by the foot, and resist the extension by an opposing force applied to the thigh. They assign as a reason for this procedure, that by so doing they avoid compressing the muscles which surround the fracture; and they assert, that such compression produces a spasmodic contraction, which renders the extension and counter-extension often useless, and sometimes even hurtful. When the fracture is reduced, they keep the limb in an extended position during the cure. This is the general practice, but I had access to see an exception. At Hotel Dieu, there were several patients with fractures of the bones of the lower extremities, under the care of M. Dupuytren; and in some of them the limbs were in an extended state,

in the thigh of a strong man. In such a case, after relaxing the muscles, we must extend till we effect reduction, which can generally be accomplished by the hands of the surgeon. We ascertain that the bones are replaced, by the touch, by the natural appearance of the part, and more especially by the comparative ease which the patient now experiences. In replacing the fractured bone, we must carefully avoid making pressure on the inferior projecting extremity of its upper portion, as was the practice with the older surgeons. This part is always in its natural situation, and only appears prominent in consequence of the upper extremity of the lower portion being depressed by the weight of the limb, or displaced by the action of the muscles.

After the fracture has been reduced, our next object is to retain the bones. This we effect by placing the limb in the posture most suitable for relaxing those muscles which have any influence in displacing the fractured bones, and by the application of splints. Splints have been made of a variety of materials, but generally of wood or pasteboard. I have been long in the habit of employing thick pasteboard, and I prefer it, because it can always [illegible] ily commanded, and because, by dippin[illegible] water, and then laying it over

[illegible] to a certain degree [illegible]
[illegible]

with glue, we are enabled to fashion it to the form of the limb, and thus have it applied more accurately than any other apparatus. In a few hours the pasteboard becomes dry, the glue hardens, and the limb is as it were secured in a mould or firm box. There should generally be two splints, of such a length as to embrace the upper and lower joints of the fractured bone; and instead of securing them by a bandage, small pieces of ribbon or tape are preferable. These should be tied circularly round the limb, and pulled with a moderate degree of tightness. One of the splints may, by softening it with water, be occasionally removed, to permit us to examine the state of the limb, and to enable us to apply local remedies. It may be kept off during the day, and laid on again at night. When inflammation and swelling succeed, the tapes should be undone, one of the splints removed, and cloths wet with a saturnine lotion kept constantly applied, or it may be requisite to have recourse to leeches. Some surgeons apply a roller next the limb, and others a piece of soap-plaster. But the roller can be of no service in retaining the bones, while it is evident that when the parts swell, it must become tight and produce strangulation; and when we use pasteboard splints, where the skin is unbroken, there seems no necessity for the intervention of any thing betwixt them and the limb. If, however, we employ wooden splints, it may be proper to interpose a few layers of lint, so as to

make them adapt themselves more accurately to the varying form of the limb, and prevent them from pressing unduly upon the fractured extremities of the bones. By laying the patient easy and cool, avoiding all tight bandaging, occasionally untying the tapes, and removing one of the splints, there is much less danger of inflammation. The callus is thus more easily formed, the cure more quickly accomplished, any accidental displacement more easily seen and rectified, and the danger of distortion much less, than when the limb is bound up with a bandage which we cannot easily undo, and in consequence of which, if the limb is at first ill set, or accidentally displaced, either in the setting or afterwards, it must remain so. When the fracture is in the lower extremity, which renders it necessary to confine the patient to bed, he should, in order to give effect to the bandaging, and to keep all steady, be laid upon one that is made of firm materials, as upon a hair matress placed above a straw paliasse.

Having thus shortly explained the general principles upon which the cure of fractures is to be conducted, I shall, under the head of particular fractures, treat of the most approved way in which each is to be managed.

OF THE PROPER PERIOD OF SETTING FRACTURES.

There are two periods of time at which it may be proper to set fractured bones, namely, immediately after the accident, and before any inflammation, swelling, or tension, have taken place; and at the distance of some days, when these symptoms have subsided. If the first period be lost, we must wait for the second, as no limb should be touched when there prevail inflammation and swelling. Some surgeons, indeed, have considered the rule, to set fractured limbs immediately upon being called to their patients, so absolute, that they have not scrupled to follow it even where there existed considerable inflammatory swelling and tension. Others again, have, in this case, merely laid the limb easy, and deferred setting it for some days. They were aware of the bad consequences of the former practice, having observed that a certain degree of inflammation and swelling followed every fracture, and that these were in many cases increased by binding up the limb, which always excited the action of the muscles, so that the bones were more readily displaced. The older surgeons, and chiefly Mr Pott among the moderns, were for immediate setting, as they conceived that no limb should be discomposed after callus began to be

formed; but the surgeons of the present day have principally adopted the secondary setting.

There are two kinds of swelling which occur after fracture,—that which immediately follows the injury and arises from effused blood; and that which takes place sometime after the accident, in consequence of increased vascular action. In the former there is neither tension nor pain on pressure; but the latter is always accompanied with both these symptoms. If the primary swelling prevails to any great extent, it may hinder us from accurately tracing the fracture, or placing the bones in exact apposition; but can never prevent us from using the force requisite to reduce it. While, if the secondary swelling exists in any marked degree, the symptoms being the consequence of increased excitement, will not only be rendered worse, if any freedom be used with the limb, but followed by violent inflammatory fever, or other constitutional derangement, and will probably terminate in suppuration or gangrene. In this case we should, in order to allay the symptoms, employ leeches and warm fomentations, before we proceed to set the fracture.

The arguments in favour of immediate setting are: 1st, that the patient will more readily submit to the measures necessary to affect it, immediately after the accident, than at a future period; while he is never free from agitation, or considers himself safe, till the fracture is set; and 2dly, that nothing tends so much to free the

patient from pain, and prevent the secondary swelling and its attendant consequences, as placing the fractured extremities of the bone in their natural situation. There is nothing that militates against the practice of immediate setting, where there is no considerable swelling from effused blood; and if no great force has been employed to effect the reduction, there seldom follows much inflammation, swelling, or tension. In addition to what has now been adduced in favour of primary setting, there arises a great objection against secondary setting, in the circumstance of its tearing up all the adhesions which are already formed in the immediate vicinity of the fracture; besides that by this practice we are in danger of increasing the pain and renewing the inflammation. Nevertheless, I admit, that if no considerable time has elapsed since the injury, nothing should deter us from putting the limb right, if it has been originally set wrong, or accidentally displaced.

If the surgeon is called to a patient who has met with a fracture, he should proceed to immediate setting for the reasons which I have assigned; but if there exists so much swelling from effused blood, which is seldom the case, that he cannot accurately trace the fracture, or properly replace the bones, he should lay the limb in the easiest posture, and wait till the swelling in some measure subsides before he proceeds to set. But if the patient has been brought from a distance;

if the limb has been roughly treated; or if the surgeon has not been called till several hours after the accident, and there has taken place inflammatory swelling; he should no doubt wait till the symptoms are allayed by local bleeding and fomentations. Lastly, if the limb is evidently distorted in consequence of the fracture not being properly set at first, or by having been accidentally displaced, the error should undoubtedly be rectified. The uniform success of La Motte, who was in the constant habit of reducing ill arranged fractured bones, after the callus had become tolerably firm, justifies this practice. I have, on many occasions, followed his example, and by moderate extension restored the bones to their natural position, without observing any bad consequences ensue.

COMPOUND FRACTURES.

COMPOUND fracture has always been considered so dangerous an accident, that it has ever been a question, whether we should immediately amputate, or try to save the limb. But I may observe, that Compound Fracture is not a definite term, and has been so vaguely used by systematic writers that no practice can be founded upon it; besides, the circumstances which are to be weighed in the surgeon's mind, are not only numerous but widely different, and therefore no ab-

solute rule can be laid down. There may be only a small external opening, with little tearing of the soft parts; there may be a wide laceration of the skin, tendons, and muscles; the bone may be simply broken without any part of it projecting, or it may be broken down into many pieces with sharp points; the fracture may be in the middle of the bone, or it may be situated near a great joint, with much injury to its tendons, ligaments, and capsule, by which the danger would be greatly increased; the patient may have met with the accident near home, have had prompt assistance, and been immediately laid in bed; or he may have been conveyed from a great distance by unskilful people, with great injury to the soft parts; there may have been a tearing of the arteries of the limb, attended with outward hemorrhage, so as to weaken the patient, or inward bleeding, like an aneurism, so as to have injected the limb with blood; perhaps before the surgeon has arrived, there may have supervened high fever, with great local swelling; lastly, dangerous inflammation may have commenced, and perhaps, before the surgeon can consult upon the case, the fatal signs of gangrene may have appeared. In compound fractures violent inflammation sometimes soon supervenes, and gangrene very frequently succeeds. When the surgeon is first called to the patient, he perhaps finds the ends of the fractured bone projecting through the wound, and the limb prodigiously swelled, but still of its

natural colour. The skin in this case soon begins to inflame; the pain increases; and the pulse becomes quick, attended with heat, thirst, headache, and other symptoms of fever. These increase; the inflammation, which is of the erysipelatous kind, rapidly extends; the skin becomes of a dark red colour, and at last livid; the pulse begins to sink on the 2d or 3d day; vesications appear upon the inflamed limb; and, in a few hours more, the gangrene is completely established. It is then too late to think of amputation; or, if the operation is to be performed, it can only be done after the gangrene has stopped.

Surgical writers are still much divided on this question, some recommending immediate amputation in every case, and others contending that we should in general try to save the limb. Whichever of these opinions we are resolved to maintain, we shall be at no loss for writers, who stand high in the profession, from whom we can adduce abundance of arguments in our favour. Some have saved their patients in most desperate circumstances; others have lost them where there had been no apprehension of danger. I have seen patients recover who have had the bones of the hand and wrist, together with the soft parts, dreadfully crushed by a heavy weight; and others who had a complete luxation of the ancle, with fracture and protrusion of the bone. I have known a gentleman recover, though with a shortening of the limb, whose thigh-bone was

much shattered by a pistol-ball in a duel. On the contrary, I have seen a man die of a compound fracture of the thigh-bone, where there was no extensive laceration, and where the bone had been quickly reduced. Many such cases are recorded by authors. In Mr J. Bell's Discourses on Wounds, there is a case of a patient dying of convulsions on the 4th day after simple fracture of the tibia, where there was neither swelling nor inflammation, nor any thing apparently to account for their occurrence. In all compound fractures we must consider the patient in imminent danger, and the question of amputation must be resolved according to the circumstances of the case. But we may say, that where the bone is fractured in more places than one, where it is much shattered, where the fracture is close to a joint, where the joint is involved, where the soft parts are much bruised or contused, where the blood-vessels are torn, where the patient must necessarily be moved from place to place, or where he is in that rank of life in which he cannot be well attended to—we ought unquestionably to amputate, and more especially when the injury arises from gunshot. On the whole, therefore, we can lay down no determinate rule with respect to this question, but must be guided in it by the nature of each individual case.

Mr Pott says, that in compound fracture "it is always the upper part of the broken bone which

is thrust forth," but in this he is certainly mistaken, for we frequently see the lower part protruded. This was the case in the very last compound fracture to which I was called. The man had fallen from a great height, so that the thigh-bone was fractured near the lower part, which I found protruding through his breeches.

TREATMENT OF COMPOUND FRACTURES.

When the nature of the injury is such that the surgeon attempts to save the limb, and there is no protruding bone, he bends it so as to relax the muscles, employs the necessary extension, and replaces the bones as accurately as possible If the bone protrudes he attempts to replace it; and if the wound be free, the muscles relaxed, and a moderate extension employed, he will most commonly succeed. When the bone cannot be returned, he must either saw off the projecting piece, or enlarge the wound; as by persisting in fruitless efforts to effect the reduction, the injury done to the soft parts will be more extensive, and the dangers will be increased. Mr Pott recommends in this case to enlarge the wound; but it is surely much more adviseable to saw off the protruded portion of bone. If we enlarge the wound we increase all the dangers of the case, because we know compound fracture to be dangerous in proportion to the laceration of the soft

parts and the size of the external wound; whereas by cutting off the projecting part of the bone, we are enabled to reduce the fracture as easily as if the wound were enlarged; and we know that the callus is always so profuse, as to supply the piece of bone which we saw off.

Should the fracture be complicated, with a bleeding artery, the surgeon must endeavour to secure the vessel by ligature. If that is impracticable without enlarging the wound to a considerable extent, a small piece of firm sponge, to which a ligature is attached, may be thrust into it; and, after suppuration is established, withdrawn by means of the ligature.

After the fracture is reduced, the limb is to be placed in a half-bent position, so as to relax the muscles; and then laid upon a tin or wooden splint, under which a piece of oil cloth is to be put. This permits the surgeon to apply fomentations if requisite; and, if suppuration should ensue, and afterwards become profuse, it is a provision for cleanliness.

After every thing has been adjusted in this manner, the surgeon should close the wound, the edges of which are to be brought together and retained by adhesive plaster. Poultices should never be applied at first, as the great object is to prevent suppuration; and if no great violence has been offered to the soft parts, the wound frequently heals without the formation of matter. Whenever, therefore, there is any disposition to

inflame, or when the inflammation appears to be greater than what is requisite to produce immediate adhesion, it should be repressed by the repeated application of saturnine lotions. If the inflammation still seems inclined to increase, it will be necessary to apply leeches to the inflamed parts, and repeat them according to circumstances; or if the patient is of a vigorous constitution, and the pulse rises, it may even be necessary to abstract blood from the arm. While we pursue these measures the patient must be kept cool, his bowels open, and the strictest antiphlogistic regimen enjoined. If, notwithstanding, the inflammation should advance, and more especially if it be attended with much swelling and tension, it will be proper to have recourse to warm fomentations and poultices, in order to promote the formation of matter. This treatment both prevents the danger of gangrene, and limits the extent of the suppuration. When the inflammation has abated, when the suppuration is fairly established, and when the symptomatic febrile symptoms are gone, we lay aside the fomentations and poultices, lest the discharge become too profuse, and then, by insinuating itself into the cellular substance, or betwixt the muscles, form si-sinuses. To prevent a too copious discharge of matter, and to support the patient's strength, he should be put upon a nourishing diet, with a moderate allowance of wine, and have occasional doses of bark with diluted sulphuric acid. If notwith-

standing this treatment, there is still a great flow of matter, the surgeon should insert his finger into the wound to feel for any loose portions of bone, which he should pick away; and if the profuse suppuration has been kept up by them, which is sometimes the case, it will subside as soon as they are removed.

When the poultices are laid aside, the sore should be dressed with simple ointment, and a little soft lint should be inserted within its lips, to absorb the superabundant pus. If the matter has been permitted to insinuate itself into the cellular substance, or has formed sinuses amongst the muscles, it must be discharged by making one or two small openings in the most depending part; and as soon as this has been effected, small bolsters of lint are to be applied, with a slight compression, so as to lay the sides of the sinuses together, and prevent them being again filled with matter.

It is certainly the most advisable practice to close the wound, and attempt to heal by the first intention, as it both greatly shortens the cure and lessens the danger; but when it fails, we should instantly have recourse to poultices and warm fomentations, which, as we have observed, prevent both extensive suppuration and the accession of gangrene, and which have a manifest influence in lessening the symptomatic fever that always accompanies high local inflammation.—When the suppuration is not profuse, the sore

soon forms granulations, which close up the extremities of the fractured bones, and then the callus by which they are re-united begins to form. But when the suppuration does become very profuse, the patient's strength sinks, no callus is formed, and he grows hectic; and, as the only chance of saving him, we must have recourse to amputation. The reasonings respecting primary and secondary amputation in gunshot wounds are also applicable to compound fractures. There are just two periods of time at which we can amputate with safety, namely, before the inflammation and other bad symptoms commence, and after they have subsided.

ON THE FORMATION OF CALLUS.

When a bone is broken, its blood-vessels with those of the marrow and periosteum are torn; they bleed profusely, and the extravasated blood is deposited round the fractured extremities of the bone. It is this effusion of blood which causes the swelling that immediately succeeds to a fracture of the long bones of the extremities. In a short time this blood is partly or wholly absorbed, and the arteries being excited by the injury assume an increased action, and throw out a gelatinous effusion, which is coagulating lymph. Into this, vessels shoot which are at first transparent, but which soon enlarge so as to transmit

red blood. By the action of these vessels the coagulating lymph becomes firm like flesh, and, after a longer or shorter time, calcareous matter is deposited, as in the first formation of the bone. Hence callus is at first soft and yielding like flesh or cartilage, but when the secretion is complete it hardens into perfect bone. In its incipient state it forms a tumor much larger than it does in a subsequent stage; partly arising from the soft parts surrounding the fracture being considerably thickened, but chiefly from the callus becoming smaller in proportion as it becomes harder. Hence the deformity after the cure of a fracture is always more conspicuous immediately after the cure, but gradually lessens through time. When the callus is fully formed, the medullary canal is at first completely obliterated, but in process of time it is restored, as in the newly-formed bone in necrosis.

When a bone is fractured, the callus is circumscribed or exuberant, according to the laceration of the soft parts; therefore slight compression seems necessary in all fractures, to prevent its exuberance and regulate its form. After a fractured rib has been united, the callus is smooth towards the pleura, because this membrane restrains it in that direction. There is generally little exuberance externally, particularly where pressure has been employed; but frequently it extends betwixt the intercostal spaces.

Du Hamel believed that callus was produced

by the periosteum. Haller denied this, and ascribed it to the bone itself; and others have attributed its formation to the medulla, particularly in the regeneration of bone in necrosis. But we know that bone may be produced from all these sources, as from the periosteum in necrosis and the formation of the teeth; and from the periosteum, the medulla, and the vessels of the bone itself in fracture. In fact any artery of the system may take on the ossific action and deposit bone, as we sometimes find in the great arteries, in the valves of the heart, in the heart itself, and even in the brain. Callus is not then an inorganized mass, or "concrete juice," as was supposed by the ancients; but is a part of the living system formed by the action of the arteries. It can be injected, is more vascular than perfect bone, and, when broken, is sooner reunited, because it is more vascular.* Its formation is retarded by a weak or diseased state of the system; and it is more quickly produced in youth, in the meridian of life, and in health, than in old age or disease; because in the former states the actions of the system are more perfect.

When inflammation runs on to suppuration, the formation of callus is prevented; hence, when the extremities of the bone in a compound fracture lie bathed in pus, callus is not formed. It does

* See J. Bell's Principles of Surgery, vol. 1st.

not begin to form till the flow of matter ceases, and the external wound begins to heal. It has been remarked by Pott, and other practical surgeons, that where the limb has, in consequence of the profuse discharge of matter been amputated for compound fracture, the fractured extremities of the bone have been found lying in the matter ununited, even at the end of many months.

That the formation of pus prevents the generation of callus is well illustrated by some of Kœhler's experiments.* In those cases where inflammation took place and suppuration succeeded, as the bones were surrounded with pus, not the smallest appearance of callus was found, although in his other experiments it was always formed where suppuration did not take place.

The generation of callus is also prevented, or at least retarded, in scurvy, syphilis, and pregnancy, or by whatever disorders the system, and renders its actions less perfect. Boyer and the generality of the French writers deny that the state of pregnancy perceptibly retards the formation of callus, but the fact has been observed by Heister and others. A case is related by Hildanus, and another still more singular by Alanson, where a bone would not unite during pregnancy. Alanson's is a well marked case. The nonformation of

* Vide Experimenta circa Regenerationem Ossium. Gotting. 1786.

callus did not arise from any constitutional disease, as the patient had been readily cured of a fractured thigh bone three months before her pregnancy. When she fractured her tibia, she was in the second month of her pregnancy, that is, she met with the second fracture only a few months after the first. The bone remained loose and ununited for seven months, but after her delivery, it began to unite, and in nine weeks after her labour she was able to walk about the room. Fractures will no doubt frequently unite during pregnancy, but that this condition is unfavourable to the formation of callus, is the general opinion of modern surgical writers, at least in this country.

FALSE JOINTS.

In consequence either of the limb not having been kept at rest after fracture, of a portion of the muscular or other soft parts being interposed betwixt the fractured extremities of the bones, or of some constitutional defect or other less apparent cause, callus is not formed, and the bones, in place of being reunited, move on each other, so that an artificial or false joint is established. In this state the fractured extremities of the bones are generally, not always, rounded; but, although we are accustomed to consider this structure as a joint, still it is ascertained by dissection that the

bones are covered, and held together only by condensed cellular substance, neither being tipt with cartilage, nor having any regular apparatus of a joint.

From all that I have seen I am convinced, that this distressing ocurrence most frequently happens from the surgeon not being sufficiently careful to place the fractured bones in exact apposition, and to retain them so. The pointed extremities are, in consequence, permitted to stick in the muscles, or, by the retraction of the lower portion of bone, brought into this situation. The false-joint may occur in any of the bones, but it most frequently happens in the os humeri, the bones of the fore-arm, and in the thigh-bone. In any of these situations it lames the patient, and is a serious inconvenience; but in the thigh the evil is more considerable, as he cannot walk without the aid of crutches.

Three methods have been proposed for the cure of false-joint, viz. rubbing the extremities of the bones frequently and forcibly upon each other;—resection, or the removal of the ends of the bones with the saw;—and the passing a seton betwixt them. All these methods are intended to accomplish the same object, which is to excite a degree of inflammation or irritation in the bone, periosteum, and neighbouring parts, by which the action necessary for the formation of callus may be renewed. The first method by friction was practised and recommended by the ancients; and

where there is a tardiness in the formation of callus, it may be of some service in accelerating the process. It has been observed, when a fracture was long of re-uniting, that by allowing the patient to get out of bed and use the limb, firmly bound up with the splints, such an action was excited as had a marked effect in promoting the union;—but when a false joint is once formed, in whatever manner it originates, we have no direct proof that rubbing the ends of the bones on each other will excite the ossific action and effect a cure; and I am not aware that it has ever succeeded.

The second method by resection consists in cutting down to the bone where it is most superficially covered by soft parts, taking care to keep free of the principal blood-vessels and nerves; then turning out the ends of the bones and sawing off their extremities, using a piece of pasteboard, or iron if needful, to protect the vessels and other soft parts from the saw. After this operation the case is to be treated like a compound fracture; the bones are to be set; the limb placed in a proper posture; the edges of the wound to be brought together and secured by adhesive plaster; and the limb to be bound up in splints, and kept in a state of rest. This operation is performed most easily in the arm, with more difficulty in the thigh, and is almost impracticable in the fore-arm. It is at the best tedious in the execution; there is danger of

its wounding the arteries, cutting the nerves, and paralysing the limb, or even of being followed by erysipelatous inflammation, gangrene, and death; and besides, though it has been many times performed, it has more frequently failed than suceeded. It has, as far I know, been done only three times with success, once by Mr White of Manchester, who was the first that performed the operation, once by Mr Viguerie of Tolouse, and once by Mr Rowlands of Chester; —while it has failed in the hands of many celebrated surgeons. I assisted Mr J. Bell, who performed this operation of resection on the shoulder-bone of a man that had met with a fracture twelve months before; but although the bones were carefully replaced and secured in a state of rest by firm splints, no union followed. It has also been done without success by Mr Long of St Bartholomew's Hospital, by Mr Cline, by Boyer, and others. In Boyer's case there succeeded violent erysipelatous inflammation and gangrene, and the patient died on the sixth day.

Dr Physic of Philadelphia having witnessed the bad success attending the operation of resection, passed a seton betwixt the ununited ends of a fractured humerus, and found that after some time there succeeded such a degree of action as produced the formation of callus, and a firm reunion of the bone. The method of cure by seton was also practised successfully, about the same time or shortly after, by the French military surgeon

Percy, and since by Mr Rigal, a surgeon of eminence resident in Gaillac, by Mr Brodie of London, by Mr Stanfield of Leeds, and by several others. The operation consists in passing a seton-needle, armed with a skein of cotton or silk, betwixt the extremities of the ununited bones, and retaining it in that situation till they manifest a disposition to reunion. That the needle may be accurately passed betwixt the ends of the bones, it is necessary, if there is any retraction, to extend the limb and bring the bones into apposition before the needle is passed; and if there is a great thickness of soft parts, it may be even proper to make a small incision down to the bone, so as to enable us to pass the needle more unerringly; although this is rather to be avoided, as more likely to produce extensive inflammation and suppuration. As soon as the seton is passed, the ends of the bones must be placed in apposition, and retained in that situation by splints and bandages; while the cord must be pulled from day to day to excite irritation, and continued till the bones show a disposition to form callus, when it should be withdrawn. If the inflammation or suppuration become extensive, the cord must be withdrawn, as these, when in excess, are unfavourable to the process of reunion.

All the methods of cure which I have now enumerated may occasionally prove successful, and cases may occur where none of them will be of any avail; but whatever method is adopted,

the ends of the bones must be securely kept in apposition, as these methods are only preliminary steps intended to induce a state favourable to the generation of callus. Friction will generally prove unsuccessful; but where it does succeed it must be in those cases where the union has been prevented by motion. Resection is tedious to perform, dangerous, and generally unsuccessful. The seton seems to be the preferable method of cure; it has more frequently succeeded than the other methods; there is less danger from its use; and it can be employed where resection is inadmissible, as in the bones of the fore-arm or leg.

PARTICULAR FRACTURES.

FRACTURE OF THE BONES OF THE NOSE.

When the ossa nasi are fractured they are in general beat in: and when this is the case, the patient does not articulate distinctly, and he respires with difficulty. These bones are so thinly covered, that fractures are always easily discovered when there is not much swelling of the soft parts; but frequently there are considerable contusion and swelling, because the fracture is most commonly produced by a blow with the fist, or other blunt body. In general, fractures of the bones of the nose are attended with no danger; but sometimes, from the violence

of the blow, the cribriform plate of the ethmoid bone is forced up so as to compress the brain and produce very dangerous symptoms; and sometimes the eye is inflamed from its vicinity to the seat of the injury. Fractures of these bones should, therefore, be treated with the utmost attention, and early recourse had to bleeding and other antiphlogistic remedies, when necessary.

Our great object in the treatment of fractures of the bones of the nose is to prevent deformity as much as possible. When the bones are beat in, the surgeon should endeavour to raise them by inserting into the nostrils the points of a pair of dressing forceps, which he uses as a levator, while with the hand he resists their being pushed too far out, and models them to their former shape. When they are once raised, they will in general keep their place; but sometimes, from being much shattered, they immediately fall in again. In this case a short canula, wrapt round with lint and dipt in oil, must be inserted into one or both of the nostrils, which will greatly assist in retaining the bones in their proper situation, and also allow the patient to respire more easily through the tube. When the soft parts are much bruised and cut, they are apt, to inflame and swell. They must on such occasions be treated with saturnine lotions, or warm anodyne fomentations, according to circumstances, and dressed with the ointment of the white oxide of lead, or some other simple ointment. The older surgeons applied, in acci-

dents of the nose, a bandage which they termed the funda or sling; and the surgeons of the present day generally employ a roller; but fractures of these bones are much better managed without a bandage, keeping the parts right and retaining the dressing by black court plaster or adhesive straps.

FRACTURE OF THE LOWER JAW.

THE lower jaw, from its exposed situation, is frequently broken by blows, by the kick of a horse, or by a fall from a height. Any part of this bone is liable to be broken; but it is most commonly fractured in the Ramus betwixt the angle and symphysis. The nature of the accident is easily detected by pain, inability to move the jaw, crepitus, and, most frequently, distortion. The bone is very easily replaced; but is more or less difficult to be retained in proportion as it is operated on by the action of the muscles, which is regulated by the situation of the fracture. The accident is in general void of danger. The fracture unites readily enough, although it sometimes terminates in necrosis, particularly where it is complicated with a wound of the soft parts.

In managing fractures of the lower jaw, the surgeon should first reduce the bone, which is very easily done by holding it firm with one hand, while with the other he draws out and pushes up

the displaced portion. He should now take a piece of cork, about five inches in length and half an inch in thickness, cut it of a semliunar form, and adapt it to the shape of the fractured jaw, leaving it half an inch broad. He now makes on its upper and lower surfaces a groove for the teeth, and then inserts it betwixt the jaws in such a situation that the line of fracture may fall in the centre of the piece of cork. This keeps the teeth in one fractured portion from rising above the teeth in the other fractured portion. He is then to take a piece of pasteboard, soak it in hot water, dip it in glue, and apply it to the lower and outer surface of the jaw; over this he must lay a succession of compresses, not confining them merely to the fractured ramus, but bolstering up the whole jaw from one angle to the other, and retaining all by means of the four-tailed roller, as described and represented in pages 490 and 491 of volume 1st When the pasteboard has dried, it will be found to have adapted itself accurately to the form of the jaw, inclosing it as it were in a case; and the piece of cork inserted betwixt the teeth serves a double purpose, not only preventing the teeth, and consequently the fracture, from being displaced, but also keeping the jaws a little asunder, and thus enabling us to convey liquid food into the stomach. In this way I have been able to treat fractures of the lower jaw very successfully. If any of the teeth should be engaged in the line of fracture, and at the same time much

displaced, it will be proper to remove them, as they are apt to prove a source of irritation. It is hardly necessary to mention, that the patient must be enjoined not to speak, and be fed on soups and other liquid food.

FRACTURE OF THE CLAVICLE.

The clavicle, from its exposed situation, is frequently broken. It is more frequently fractured than luxated, and, when broken, the injury is easily discovered, because the whole arch of the bone is exposed. In this case, upon moving the arm, there is distinct crepitation. The weight of the arm pulls the scapular portion away from the sternal; and the point of support being gone, the arm and shoulder fall forward to the breast. From the shoulder carrying the scapular portion with it, the sternal portion of the clavicle can be felt raised and projecting, although, for reasons formerly mentioned, it must always be in its proper situation.

The only setting which the fractured clavicle requires, is to brace the shoulders back, which lengthens the space betwixt the sternum and the top of the shoulder; and to raise the arm, by which the scapular portion of the bone is brought up to the same level with the sternal portion. The shoulders cannot be pulled too far back, as the adhesion of the subclavian muscle prevents it.

They are generally braced back by a double-headed roller, applied in the form of the figure of 8, and crossed upon the back. Although this answers the purpose sufficiently well, I have generally been in the habit of bracing them back by means of an apparatus similar to what is used to form the shape of young people, called a monitor. It is more easily applied than the double-headed roller, it acts more powerfully, and, by tightening the straps, its operation can be more readily increased. But whichever of the two we use, we should at the same time always introduce a large soft compress into the axilla. This keeps the arm farther from the side, and lengthens out the fractured clavicle. We now bend the forearm, raise it to such a height as is sufficient to bring the scapular portion of the clavicle on a level and in contact with the sternal portion, and maintain it so by inserting it into a handkerchief slung round the neck. Either of these apparatus leaves the fracture so exposed, that the surgeon can easily apply saturnine lotions, or leeches, if needful; and he has it at all times in his power to examine the state of the parts. It may be worth while to mention, that if the accident has happened to a young lady, it is advisable to apply over the fracture either an adhesive plaster, spread on leather, or a piece of pasteboard soaked in hot water, and dipt in glue, which will prevent an exuberance of callus, and consequent deformity.

FRACTURE OF THE SCAPULA.

THE scalpula may be fractured either in the acromion process from its projecting situation, or in the body of the bone. In the latter situation it is most frequently broken at its lower angle. When a person is thrown from a horse, or falls from a height, and pitches on the shoulder, he neither dislocates the shoulder-bone, nor in general fractures the acromion process; because from the manner in which the scapula is placed upon and connected with the chest, it glides so as to elude the blow. The acromion process is therefore, in general, fractured by a direct blow, as by a bludgeon, or from the fall of a heavy body. In the fracture of this portion of the bone there is seldom much distortion, although the deltoid muscle pulls the process downwards, while the levator scapulæ and trapezius pull the body of the bone upwards and backwards, so as to cause displacement.—There is great pain, particularly on motion. A crepitus is perceived when the fingers are applied, and when the shoulder bone is pushed up from the glenoid cavity, the acromion process can be felt rising.

In the management of this fracture all that is required is to place the arm in such a situation that the deltoid muscle may be relaxed, and that the shoulder bone may push up the depressed pro-

cess. For the accomplishment of these purposes we bend the fore-arm and raise the arm to such a height, as completely to relax the muscle and replace the fractured process. We retain the arm in this situation, by the introduction of a large pad or small pillow betwixt it and the side, and we support the fore-arm by a handkerchief suspended round the neck. No bandage is in general required, but, the injury being inflicted by a blow, the soft parts are commonly so bruised that it is requisite to apply leeches and saturnine lotions. If we have recourse to a bandage to keep on the compresses, which are to be wet with saturnine lotions, or other dressings, it is the spica bandage that we employ, as described and represented in pages 487 and 488 of Volume 1st.

When the inferior angle of the scapula is fractured there is no distortion nor inability to move the arm, but there is great pain. The serratus major anticus, to which this portion of the bone is attached, draws it forwards; and when we raise the scapula and move the body of the bone, this portion can be distinctly felt detached and separated to some distance. In the treatment of this fracture, we bend the fore-arm, lay the hand over upon the opposite breast, and carry the arm downwards and forwards, so as to bring the body of the bone as near as possible to the inferior angle. To retain it in this situation, the arm must be bound down to the side by a cir-

cular roller, and the fore-arm placed in a handkerchief suspended round the neck.

FRACTURE OF THE SHOULDER BONE.

The os humeri, from its exposure, is very liable to be fractured by blows and falls. It is more frequently broken near its middle,—and in this case the fracture is in general nearly transverse. This injury is always easily detected by the inability to move the arm, by the distortion, and by the crepitus. If the bone be grasped by one hand above the seat of the injury, and below it by the other, we can, by rolling the arm feel the one end of the bone rubbing on the other.

The humerus is also sometimes fractured near its neck, while, in young subjects, the head or epiphysis is, in consequence of external violence, separated from the shaft of the bone. This latter case, which is apt to be confounded with luxation of the shoulder joint, is more difficult both to detect and to manage. There is this marked difference betwixt separation, as well as fracture, and luxation, that in them, the limb is always free and can be moved in any direction, whereas in luxation the bone is fixed and the limb is immoveable. In them, therefore, the Surgeon, by running the fingers along the spine of the scapula till he arrives at the point of the acromion, and then inserting them under that process, will be enabled

to feel the head of the bone in its place; and on now moving the limb with the other hand, the head of the shoulder bone, if separated from the shaft at the intervening cartilage, will not be felt to roll in the glenoid cavity, but rubbing as if upon a hard body, whilst, if fractured a crepitus will be perceived. Besides, in these cases no tumor can be felt in the axilla, as in the case of luxation.

When the fracture is near the head of the bone it is always somewhat oblique. There is consequent retraction, in proportion as the fracture is situated near the head of the bone, although it never prevails to the same degree, nor requires the same force to overcome it, as in the case of fracture of the thigh. When the fracture occurs below the tuberosities and above the insertion of the pectoralis major, latissimus dorsi, and teres major, the inferior portion of bone is always retracted upwards and inwards;—When the fracture is below the insertion of these muscles, but above the insertion of the deltoid, it is pulled upwards and outwards; when in the middle of the bone, there is little displacement; and when it happens immediately above the condyles, the bone remains in its right place and there is no shortening of the limb.

When the bone is fractured in the middle or below it, it remains nearly in its right place and direction, and all that is requisite is to stiffen the arm and thus support the bone. We therefore apply two splints—one extending from the acro-

mion process or top of the shoulder to beyond the outer condyle—and the other from the axilla to beyond the inner condyle. These splints should be of firm pasteboard. The Surgeon as in the management of other fractures, is to soak them in hot water to soften them and make them pliable; and then dip them in glue. Before he applies them the fore-arm should be bent, to relax the muscles. He may now either apply a common roller, for this is almost the only case where the old method may be used, or an eighteen tailed bandage, or simply three tapes. The roller is more secure than tapes, and therefore is preferable. The arm should be tied down to the side, and the fore-arm supported in a sling.

When the fracture occurs near the neck, the Surgeon bends the fore-arm, and makes an extension, necessary to bring the ends of the bone in contact, which is always easily accomplished. He then lays a pasteboard splint, as already directed, along the inner side of the arm extending from the axilla to beyond the inner condyle; and another on the outer side of the arm, extending from the acromion process to beyond the outer condyle. He should now introduce into the axilla a moderately sized compress, and apply the spica bandage, carrying it as a roller down the arm to the elbow. The hand and wrist must be put into a handkerchief suspended round the neck, and placed high upon the breast. The arm being in this manner left unsupported at

the elbow, its weight contributes greatly to prevent retraction and keep the fractured extremities in apposition. The arm should be tied down to the side by a roller passed round the body.

FRACTURE OF THE BONES OF THE FORE-ARM.

The radius is more frequently fractured than the ulna. It may be broken by direct blows, but perhaps it is more often broken by falls upon the palm of the hand. When falling we naturally put out the hand to save ourselves, and in this case the radius, from its connection with the wrist, bears all the force, while the ulna, from its little share in the joint, escapes unhurt. A fracture of the radius is very easily discovered. We are directed to the seat of the injury by the pain ;—by running the fingers along the bone, we feel the point at which it is fractured; by holding the fore-arm firm above the seat of the injury with one hand, and grasping the patient's hand with the other and rolling it, we hear the crepitus; lastly, if we let go the hand, it falls inwards. The motions of pronation and supination are effected entirely by the rolling of the radius upon the ulna, and this power of rotation is possessed independently of its bending along with the ulna upon the shoulder bone. Now as the ulna supports and keeps the radius of its proper

length, the chief thing the surgeon has to attend to, in the management of this fracture, is to settle the proper posture of the hand and prevent it falling inwards. If he were to turn the hand prone, the lower head of the radius would in this case have rolled two thirds of a circle round the ulna, and the lower end of the bone having thus moved while the upper end remained fixed, the fractured extremities would be placed far from each other. If the bone were allowed to reunite in this situation, there would follow not only great deformity, but a great degree of lameness, as the turning motions of the hand would be much circumscribed. Again, if he were to turn the hand supine, the pronator quadratus, a broad muscle which is attached to the radius near the wrist, would keep down the lower end of the bone, and depress it so that it would not be in contact with the other. The hand therefore must be kept neither prone nor supine, but exactly in the middle betwixt pronation and supination. The true setting of the bone is to place the radius in a line with the thumb, and the ulna in a line with the little finger, bending the fore-arm, and inclining the palm of the hand towards the breast. There is not much extension required. To keep the bone right, it has been customary to apply two splints, one along the inner and the other along the outer side of the arm.

We have just now remarked that the great

art in the management of fractures of the radius, is to prevent the tendency of the hand to fall inwards, or the lower portion of the bone to roll away from the upper,—the use of the hand being preserved free, in proportion as the ends of the bone are retained in contact, and the hand kept from falling prone. I have found that this object was more easily attained by surrounding or incasing the fore-arm in one large splint than by employing two. The Surgeon may take a large thick pasteboard splint, of such a length as to extend from a little above the elbow nearly to the points of the fingers, and so broad as to go at least three fourths round the circumference of the limb. After having soaked it in hot water, and dipped it in glue, he is to lay it upon the ulnar edge of the arm, gently bending the elbow and the fingers; as keeping the fingers quite extended during the cure is both very painful, and makes the muscles tense. The Surgeon is then to bring up the splint so as to incase the whole fore-arm except the radius, and to secure it by means of three tapes, one passed immediately below the elbow, another a little above the fracture (supposing it to be near the wrist), and the third across the hand. The splint comes so far up upon the palm of the hand as to prevent it from falling inwards; but, for additional security, he should lay a strip of firm wood two inches broad along the inner side of the splint extending its whole length, and fasten it by tapes; lastly

the fore-arm should be supended by a handkerchief round the neck.

When both bones are fractured, the injury is at once discovered by a half bent state of the fore-arm; by a projection of the extremities of the fractured bones, easily felt under the skin; by an inability to lift the hand without support; by the crepitus; and by motion at the seat of the fracture. In this case the lower portions of the bones are generally drawn towards each other by the action of the pronator quadratus muscle. The bones are set and retained exactly in the same way as if the radius only were fractured, except that it is requisite to employ some degree of extension to place the bones in apposition.

FRACTURE OF THE OLECRANON.

The olecranon, from its exposed situation, is frequently broken by blows and falls. It may also be broken by the strong action of the triceps, which is inserted into it, as in aiming a blow or throwing a stone; although I believe this to be rarely the case. This fracture is readily distinguished by a hollow at the elbow, into which the finger can be inserted; by the broken process being felt high in the arm above the elbow: by the fore-arm hanging lame by the side in a half bent position; and, when the patient at-

tempts to extend it, by a sensation of something separating at the elbow. It is also observed that the muscles have no command over the fore-arm, and that by moving the olecranon laterally no motion is conveyed to the ulna.

The ancients were unacquainted with fracture of the olecranon; the Arabians take but slight notice of it; and Petit is the first who describes it, although he gives no directions for its management different from those required in other fractures of the ulna. It was the prevailing opinion in his day, that fractures of bones, in the immediate vicinity of joints, were always attended with the exudation of callus into those joints, and consequent anchylosis. The surgeons at that time therefore always kept the fractured extremities at some distance from each other, to make room for the callus. Du Verney was the first who particularly understood this matter; and of late years fractures of the olecranon and patella have been managed more scientifically. In the treatment of them they have been classed together; and it has been established as a rule of practice, that, although in almost all other fractures we bend the limb, in these two cases we extend it.

In the management of this fracture we therefore extend the fore-arm, to place the end of the ulna as near the separated process as possible; and bring down with the hand the retracted olecranon, placing it as near in contact with the shaft

of the bone as we are able. We retain it in this situation by a roller passed round the elbow, in the form of the figure 8; and, to keep the arm extended and ensure the apposition of the fractured extremities, we lay a splint along the fore part of the joint, extending from the middle of the arm to the middle of the fore-arm,—securing it by a roller, which, besides retaining the splint, tends greatly to prevent the contraction of the triceps, and its consequent action upon the fractured process. The union, which will generally take place in three weeks, is not effected by osseous matter, but by a ligamentous substance. Previous to the complete union, in ten or twelve days we should begin gently and cautiously to bend the arm so as to prevent a stiff joint,—using a little more freedom every day; and while we do this, the olecranon should be kept down by the hand for fear of accidents.

Desault directs the arm not to be completely extended; but to be kept betwixt the half bent and extended posture. The reason he assigns for this is, that if the fore-arm were completely extended, the end of the fractured ulna would be forced into the cavity of the olecranon, and pushed more forward than the other fragment, and that consequently the union would be irregular. But this does not seem to have happened in those cases where the fore-arm had been kept completely extended; and it has been the practice of the best surgeons to treat fractures

of the olecranon precisely like fractures of the patella, namely bringing the broken pieces as nearly into contact as possible by extending the limb. It is evident that if the fore-arm be kept bent in any great degree, the new matter that will be interposed betwixt the extremities of the broken bones, will forever after keep the fore-arm from being completely extended, and produce the same effects as anchylosis. This has frequently happened, and to prevent the possibility of a recurrence, I think the limb should be kept completely extended.

FRACTURE OF THE CARPAL AND METACARPAL BONES, AND PHALANGES OF THE FINGERS.

These bones are more frequently luxated than fractured. When fractured by the fall of heavy bodies, by machinery, or by a carriage wheel, there is great contusion of the soft parts, succeeded by considerable inflammation and swelling. These effects are best allayed by the free application of leeches, followed by warm opiate and saturnine fomentations. When fractured by gunshot, the injury is of the worst kind, and frequently requires amputation. When the bones are simply fractured, the fracture is at once detected by the inability of motion and by the crepitation; and the case is easily managed. If one or more of the carpal or metacarpal bones

be fractured, all that is necessary is to lay out the hand smoothly upon a pillow, or place it upon a pasteboard splint extending the whole lengh of the fore-arm. If the phalanges of the fingers are broken, the bones are to be replaced and bound up, like the long bones, with pasteboard splints and a tape or narrow circular bandage.

FRACTURE OF THE STERNUM.

The sternum may be fractured by a blow with the fist; but it is most commonly fractured by a heavy weight, as by a carriage wheel passing over it; by the kick of a horse; or by heavy pieces of machinery. In such cases the accident is commonly fatal. The mediastinum is situated immediately under the bone, the pleura and pericardium are contiguous, and the whole are continuations of one membrane. These parts are very susceptible of inflammation, and this, when excited in one part, has a tendency rapidly to overspread the whole cavity. Other consequences of this crushing of the sternum are, depression of the bone, bursting of blood-vessels, and effusion of blood into the chest. If the patient escape these immediate dangers, suppuration is apt to follow, which is generally profuse and accompanied with slow exfoliation of the sternum. This endangers hectic, but at all events, there is

a protracted tedious cure. When the fracture has not been caused by great violence, and there is no injury done to the parts within the chest, the fracture reunites readily enough, although the sternum is a light and spongy bone.

The nature of the accident is ascertained by several well marked symptoms. There is dreadful pain, which, when the fingers are drawn along the sternum, is particularly severe at one point. As the extremity of the bone is alternately raised and depressed, there is crepitation at each respiration; and this can sometimes be heard at the distance of several yards. The patient feels the bones jar when he coughs or even breathes; and if the surgeon lay his hand upon the breast, he will generally be able to feel it. There is great depression, with cough and difficulty of breathing. The patient is unable to lie down, and when the injury is severe, there is an inequality in the bone, one portion being depressed or raised above the level.

As inflammation and its consequences are to be chiefly apprehended, the use of the lancet is to be freely had recourse to, and repeated till all the distressing symptoms cease. For the first week the patient cannot lie down in bed, but remains in a sitting posture with his head inclined forwards. At length the difficulty of breathing, oppression, cough, and other distressing symptoms abate; the pulse becomes more regular; the immediate danger is over; and there

is now a chance of his recovery. But if the contusion has been great, the bone much shattered, and the inflammation extensive, suppuration follows, a tumour appears which should be opened early, fragments of bone are discharged, the sternum becomes carious, there is a profuse flow of matter, and hectic generally supervenes. In this case we have recourse to bark and wine, diluted sulphuric acid, a nourishing diet, and country air, with such exercise as the patient can conveniently take.

The chief distress arises from the motion of the sternum. There is a greater degree of it at its lower part; and as it is this motion which causes the grating of the bones, provokes the cough, and excites the inflammation; if we can prevent it we give great relief. To effect this, the Surgeon should lay a large adhesive plaster across the sternum, and apply a tight bandage round the lower part of the chest. The bandage we employ is the napkin and scapulary, described and represented in pages 491 and 492 of Volume 1st. This gives instant relief, and should be pulled so tight as to prevent all motion of the chest, as the diaphragm alone is sufficient to carry on respiration.

It has been recommended in some cases of fractured sternum to make a crucial incision and apply the trephine. But the preferable practice seems to be, to exclude the air,—to apply a tight bandage, to repress the inflammation and other bad

symptoms by bleeding, and never to operate till suppuration has taken place, unless we can distinctly feel a portion of bone driven in or standing perpendicularly up.

FRACTURE OF THE RIBS.

Fracture of these bones is a common occurrence. When a rib is simply broken across, without any other wound than of the muscular parts which immediately surround it, the injury may be called a simple fracture. When the pleura is pierced, and the lungs wounded, as well as when the skin is pierced, (which is sometimes the case), it may be denominated a compound fracture. The first is attended with so little danger, that it often passes unobserved; but a variety of accidents is apt to follow the second.

A simple fracture of the ribs is discovered by the nature of the blow or fall, by the pain at a particular point, and by a crepitation being felt when the fingers are run along the course of the injured ribs, which is even perceptible in the common state of breathing, as well as upon raising or depressing them. When the fracture is compound, from the spiculæ of the broken bone puncturing the pleura and lacerating the lungs, air escapes into the cellular substance, and there takes place emphysema more or less extensive in proportion to the injury. This is attended

with cough, difficulty of breathing, and sometimes a spitting of blood. Independently of the emphysema, the great distress it produces and the spitting of blood, the intercostal arteries are sometimes torn in compound fracture, and blood is effused into the cavity of the chest, compressing the lungs and endangering suffocation; or such a degree of inflammation is induced as terminates in collections of matter in the breast, forming the disease we call empyema.

In the treatment of simple fracture of the ribs there is no occasion for reduction or splints. The adjoining ribs serve as splints, and the ligaments and intercostal muscles keep the fractured bones in their places. So little assistance is required that the accident often happens and the injury passes unobserved. But as the motion of the chest causes the fractured extremities of the ribs to rub on each other, producing a great degree of pain, and exciting inflammation and cough, which when neglected endangers suppuration, these consequences must be prevented by restraining it. The treatment is extremely simple. The surgeon should first apply over the injured part a large diachylon plaster spread on leather, then a tight roller round the chest, or the napkin and scapulary bandage. He should bleed, if necessary, to prevent or subdue inflammation; and if the patient is a young and strong man, this precaution should never be neglected; opium

may afterwards be given to allay the teasing cough.

This is the plainest view of the case—but in stead of the simple fracture of one or two ribs it sometimes happens that the fracture is compound. In this case several of the ribs are beaten in; their sharp spiculæ wound the lungs; and the air escapes into the cellular substance, forming emphysema. Here the pain is violent, the difficulty of breathing and cough great, the patient is unable to lie down but must sit up erect in a chair, and the danger is extreme. We are advised by some writers, to bend the trunk over cylindrical bodies, to try variety of posture, and even to make an incision to raise the depressed ribs. This appears to me to be dangerous practice;—and I apprehend all that can be done is to bind the thorax tight so as to repress the action of the ribs; to bleed profusely to keep down inflammation; and, if the emphysema is extensive and troublesome, to make several small punctures with a lancet in order to allow the air to escape.

I was some years ago called to a case of this kind. The horses in a carriage took fright, and ran off; the spring of the coach-box broke; and the coachman, and footman who was sitting along side of him, were precipitated from the box,—by which means the former suffered a compound fracture of one of his legs which required aputation. The horses now ran from the middle of the street upon

the pavement and crushed betwixt the carriage-pole and the wall a young man who was passing. His lower jaw was fractured, and the pole striking also his right side, fractured and beat in the second, third, and fourth ribs, near where they join the sternum. He was taken up almost lifeless; and when I first saw him, three hours after the accident, he was supported up in bed, being unable to lie down,—the difficulty of breathing was extreme,—the chest heaved violently,—a crepitation was distinctly felt,—there was emphysema over the superior part of the thorax,—and when I laid my ear to the seat of the injury, I heard the air rushing from the lungs, loud like the noise of the bellows in a smith's forge. Having bound the thorax tight with a shawl, which gave considerable relief, I applied a roller across the shoulders, to repress all motion; and ordered him to be largely blooded. In a few days I undid the bandage, applied a large diachylon plaster spread on leather to the seat of the injury, and bound all up again. The emphysema disappeared in a short time, the crepitation became more obscure, and the breathing grew easier. He was unable to lie down in bed, for the first eight days, or even to recline backwards; but sat continually upright, supported in an arm-chair. But he at length recovered; and I then perceived in the seat of the injury a depression so considerable as to admit my fingers,—while the back part of the same ribs, near where they join the

vertebræ, was forced out so as to cause considerable deformity.

FRACTURE OF THE BONES OF THE PELVIS.

When the bones of the pelvis are fractured, which sometimes happens from falls, a carriage wheel passing over the body, or the being crushed by a heavy piece of machinery, the injury is very serious. There is always great contusion of the external soft parts, and most frequently considerable ecchymosis. The contained viscera are frequently so much hurt that either the bladder is ruptured, or the parts are so disabled that no urine can be passed. We are informed of the nature of the accident by the extreme pain, by a crepitation perceptible even to the patient upon a change of posture, and by inability to walk or stand.

In fracture of bones of the pelvis there is seldom any displacement, and all that we can do is to bind the parts firmly up with a circular bandage, or, if applicable, with the spica bandage as described and delineated in pages 487 and 488 of Volume 1st. As the chief danger to be apprehended arises from the injury done to the pelvic viscera leading on to inflammation, which may terminate in suppuration or gangrene, we must bleed largely, and pursue a strict antiphlogistic regimen. If the patient cannot pass the urine, it

must be drawn off evening and morning by the catheter, and the rectum must be regularly unloaded by glysters.

FRACTURE OF THE THIGH-BONE.

While fractures of the bones of the upper extremity are easily managed, in those of the lower we frequently experience the greatest difficulty. From the number and strength of the muscles which move the thigh and leg, the femur is no sooner broken, especially in a strong man, than it is powerfully retracted. The soft parts are also frequently wounded, and hence compound fracture occurs more commonly in the thigh-bone than in any other situation. In laying down principles for the management of fractures Surgical writers have always had in view their application to those of the lower extremity, as it is in them that all the difficulties occur, and for which the chief mechanical contrivances have been invented.

Although great force is required to fracture it, yet the thigh-bone is frequently broken. It may be broken in its neck, in its middle, or nearer the condyles; but it is generally broken in the middle, or a little below it. When the bone is broken directly accross, and the fracture is what we call transverse, it is a case much more easily managed than when it is oblique;

but, most unfortunately, from the position of the thigh bones, the fracture is more commonly of the latter description. The higher the fracture is situated, it is always the more oblique; hence all those fractures which occur above the middle of the bone are oblique, while those which are situated in its lower part, a little above the condyles, are generaly transverse. When the fracture is oblique, the ends of the bone pass each other; they are kept in apposition with difficulty; and when a cure is accomplished the limb is apt to be shortened.

It may be laid down as a fixed principle, founded on experience, that the higher the fracture, the greater the difficulty of keeping the ends of the broken bone in contact, and the greater the chance of lameness from the shortening of the limb. When the bone is fractured in the neck, all those muscles which are implanted into the trochanters, as well as the triceps with the flexors and extensors, retract the lower portion of the fractured bone most powerfully; and no machinery can keep it extended so as to prevent deformity. When it is fractured a little lower, we have to oppose the action of the glutæus maximus, of the pectinalis, and of all the heads of the triceps, conjoined with the flexor and extensor muscles of the leg. When the bone is broken at the middle, or below it, the retraction is not so great, but still the adductor magnus or lower portion of the triceps with the flexors and

extensors so far retract the bone as to make it difficult to retain; and when the femur is fractured at the lower part, immediately above the condyles, it is the case most easily managed because there are few muscles which can affect it. The fracture in this case is generally transverse, and the bone is naturally so broad that the fractured ends will more readily come into contact, and the opposing surface will resist the retraction of the lower portion.

Fracture of the shaft of the thigh-bone is most frequently produced by falls from a height, or by a carriage-wheel passing over the limb. The fracture is easly discovered by inability to move the thigh; by distortion and generally shortening of the limb by acute pain from the spiculæ of bone wounding the soft parts; by the mobility of the lower part of the limb; by crepitus, if the bone is not retracted; and, if this is the case by a crepitus being distinctly perceived on the extension of the limb to its former length. When the fracture is in the neck of the bone, it most commonly occurs from falls upon the great trochanter; but it is not unfrequently produced by falls upon the feet, the whole weight being then thrown on the leg of the injured side. This fracture is more difficult to detect than fractures of the shaft of the bone, as it is apt to be confounded with luxation upwards and backwards. By reflecting however upon the state of the limb, and by careful examination, fracture can always

be sufficiently distinguished not only from this species of luxation, which is the only one with which it can be confounded, but from every other accident In fracture, as in this luxation, there is deformity, with shortening of the limb loss of motion and violent pain; but in the former, the limb is quite moveable, whereas in the latter it is fixed, being checked by the new position of the head of the bone. If the surgeon lay hold of the patient's leg at the ancle with one hand, while he places his other upon the great trochanter, and then rolls the limb, the trochanter, when the neck is fractured, will move as it were upon a pivot, describing a very small circle; whereas if luxated, it will be immoveable, or only capable of being moved in a small degree, with difficulty and extreme pain. If the neck of the bone is entire, the limb will describe a large circle. When the thigh-bone is broken at its neck, the fracture generally occurs within the capsular ligament; but, in consequence of extreme violence, the bone is sometimes broken without the ligament, at the root of the trochanters. At which ever of these points the fracture is situated, there is always a shortening of the limb; but when it is within the capsule the retraction is not near so considerable as when it is immediately without it, because the capsule prevents the bone from being entirely retracted. There is also this difference betwixt a fracture within and a fracture without the capsular ligament, that in

the latter, there is more pain from the spiculæ of bone wounding the muscular and other soft parts.

In consequence of retraction of the bone, it is evident that there can be no crepitation till the limb is extended to its former length, but as soon as this is done the crepitation is distinct. In luxation upwards and backwards, while the limb is shortened, the toes are turned inwards; but no sooner is the neck of the thigh bone fractured, than the foot and toes turn outwards. This no doubt arises in part from the predominant power of the glutæi and other rotatory muscles which are implanted into the trochanter major; but this position of the foot and toes is rather a natural consequence of the weight of the limb,—for if we turn the toes in they will remain so. They are sometimes placed in this situation by chance, and might give rise to an error in the diagnosis. Although therefore in fracture of the neck of the thigh-bone, the foot and toes naturally fall outwards, this circumstance cannot be received as a conclusive sign. Indeed Parè Petit, and Mr B. Bell describe the foot and toes as uniformly turned inwards; but I may remark that, in luxation, the toes are always turned inwards, and cannot be turned completely outwards; whereas although we should find them turned inwards in fractures, they can easily be turned entirely outwards. When the marks of fracture of the thigh-bone are present, when the subject is young,

and when the crepitation is indistinct, we conclude that the case is rather a separation of the epiphysis from the shaft of the bone at the intervening cartilage than a fracture.

We have already remarked that the chances of lameness are in proportion to the proximity of the fracture to the neck of the bone, and to its obliquity. When the fracture is situated in the neck, it is hardly possible completely to prevent the retraction of the limb; and as all those machines which have been contrived to keep up a permanent extension are attended with such torture that they can hardly be endured, they are seldom resorted to by English surgeons.*

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* In oblique fractures of the thigh and leg, the French surgeons, by the aid of machinery, keep up a permanent extension to prevent the retraction of the bones. Boyer denies that continued extension produces so great an irritation as excites spasmodic retraction in the muscles, provided it is not applied till the first irritation subsides, and is carried no farther than only to resist their retraction. The same writer directs that any inflammation and swelling that occur should always be allayed by emollient cataplasms before the extending apparatus is applied. To reap every possible advantage from the permanent extension, and to prevent it being painful, the French surgeons direct the following rules to be adhered to.

1st, To avoid compressing those muscles in immediate contact with the fracture, and whose elongation is necessary to

In the management of a fractured thigh-bone our great objects are to relax those muscles which have the greatest influence in displacing the fractured bone; to employ such a degree of extension as is sufficient to place the ends of the bone in apposition; and to endeavour to maintain them so by posture and gentle bandaging, while we from time to time rectify any occasional displacement. To effect these ends the patient should be laid upon a hair-mattrass, placed upon

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restore to the limb the length which it has lost. With this view the extending and counter-extending powers must be applied upon those parts of the limb which are below and above the joints connected with the fractured bone.

2dly, The extending and counter-extending powers should be applied to as large a surface as possible.

3dly, The extending power ought to act in the direction of the axis of the fractured bone.

4thly, The permanent extention ought as much as possible to be slow and gradual, operating in an almost insensible manner; as a sudden and violent extension would excite spasmodic contraction of the muscles, which, instead of lengthening, would rather lacerate them.

5thly, To protect the parts upon which the extending and counter-extending powers act, and to render equable the compression produced by the lacs and bandages or the apparatus made use of. To effect this double purpose, it is necessary to protect the parts upon which the lacs are applied, to fill up the hollows with charpee, and to give to the limb a circular form, in order that the compression may be uniform.

Boyer asserts that by following these rules, the permanent extension is always supportable, even by the most delicate person.

a firm bedstead; the knee should be bent, and the body placed in a reclined posture, by which the pelvis will be bent upon the thigh. This position of the limb will most effectually relax the muscles which have the greatest influence in displacing the fractured bone. An assistant should now grasp the thigh with his hands firmly above the seat of the injury, or, if the fracture is high up, a towel or table-napkin may be passed over the pelvis by the perinæum, carrying one end over the groin and the other across the hip of the fractured side; and if necessary another assistant may lay hold of the patient's body, to assist in resisting while the surgeon attempts to reduce the fracture. Every thing being adjusted in this manner, the surgeon must now proceed to extend the thigh; and if the patient be a child or a delicate female, it will be sufficient for the surgeon to grasp the thigh firmly with his hands above the condyles, and employ moderate extension, while the assistant resists. The bone will be immediately reduced, as the muscles act but feebly; but if the patient be a big and strong man, in whom the muscles act with great power, the surgeon will need to fasten, above the condyles, a hand-towel or table-cloth, in order that he may be able to make the necessary extension. After he has reduced the bone and brought its ends in apposition, the surgeon should take a long thick pasteboard splint, and, after soaking it in hot water and dipping it in glue, apply

it upon the outer part of the thigh so as to extend from above the trochanter major to beyond the knee. He should now in a similar manner apply another splint to the inside of the thigh, of sufficient length to extend from the groin to beyond the inner condyle. These splints are to be retained in their places by the eighteen-tailed bandage, which is preferable both to the roller and to tapes,—to the roller, as it can be easily undone without discomposing the limb; and to the tapes, as it embraces the thigh more closely and makes a firmer and more uniform compression. In a few hours the pasteboard hardens, and forms a firm case round the thigh; and this, conjoined with the firmness of the bandage, which should always be pretty tight, has a powerful effect in preventing the action of the muscles. It is found by experience that nothing tends to prevent their action so much as compression. After the thigh has been thus bandaged up, it should be laid with the leg and foot in the machine of which there is a delineation in the 2d volume of Mr C. Bell's System of Surgery; in that represented in the 2d part of Messrs A. Cooper and Travers' Surgical Essays, and which has been long used at Guy's Hospital; or rather in the machine represented in the annexed drawing, which I conceive to be an improvement on their construction.

This machine was constructed by Mr Fortune, an ingenious artificer of this city, at the suggestion

of Mr Gillespie, and first applied by this gentleman to a case in the Royal Infirmary here, at which institution it is now generally used. It is superior to the other two, inasmuch as it is supplied with a foot-board which steadies the foot and leg; and, with the assistance of side-boards, effectually prevents their tendency to fall outwards. It has two hinges, one at the hip, and another at the knee, by means of which, with the assistance of a screw, the angle at the knee can be increased, or diminished, as in Mr Cooper's; and by means of two other screws, the thigh and leg-boards can be shortened or lengthened. This not only permits the surgeon to adapt the machine to a boy or man, but enables him to make a slight extension when he finds it necessary; and this it is able to effect, by fastening the foot to the foot-board by means of a band passed round the ancle and foot. The annexed plate is a representation of the machine.* Before the limb is pla-

* For the explanation of this plate, see next page.

ced in it, a quantity of tow, or two long cushions, should be laid upon the thigh and leg-boards, which not only makes the limb lie easier, but enables us to bolster it up and support it, by which means the leg and thigh are prevented from rolling outwards and displacing the corresponding points of bone.

In the management of fracture of the thigh-

EXPLANATION OF THE PLATE.

A. The thigh-board, consisting of two pieces, which are so placed with respect to each other as to permit of its being shortened or lengthened by means of a wheel and pinion, at B. C. The leg-board, also consisting of two pieces, and capable of being in like manner separated or brought together, by turning the wheel and pinion at D. To the upper portion of each of these boards is attached a tin plate, which lies over the lower portion, and supplies the vacant space in the wood when the boards are separated. The tin should be japanned to prevent it rusting. E. The foot-board, capable of being bent and extended or inclined laterally by means of a ball-and-socket joint at its junction with the leg-board. When the foot-board is properly adjusted, it is fixed by a screw. F. F. F. F. Side boards to support the limb. These should be so attached, that they can be removed or let down by means of a hinge, so as to permit the surgeon to apply dressings, or occasionally to examine the state of the limb. G. A tenter nail and bush, by means of which, with the assistance of a hinge at the knee and another at the hip, the angle at the knee is increased or diminished. The whole machine, with the exception of the tin plates, is made of wood, and the whole machinery is moved and regulated at the points B. D. and G. by a small winch like the key of a clock.

bone, the surgeon ought in a particular manner to attend to the position of the patient's body, and the adaptation of the machine to the situation of the fracture; as upon these depend the correct apposition of the fractured extremities of the bone and the prevention of deformity. If the fracture is high, and in proportion as the patient's body is laid horizontally the upper extremity of the fractured bone will be raised and project forwards; and in proportion as the angle at the knee is increased or diminished, or, in other words, as the knee is more or less bent, the fractured extremity of the lower portion of bone will also be lowered or raised. Hence if the fracture were situated high, the patient's body laid horizontally, and the knee not much bent, both the ends of the bone would project forwards, and be reunited at a considerable angle. To prevent this, the knee must be bent and the patient's body raised so as to approach the sitting posture, in proportion as the fracture is high; and in some cases it may be even necessary to lay a splint along the fore part of the thigh.

The shaft of the thigh-bone, when fractured, generally unites in six weeks or two months; but this must in a great measure depend upon the period of life and the general health. When the neck is fractured within the capsule, a much longer time is required before a complete union is accomplished, and this is never affected by ossific matter, but by a ligamentous substance.

In extreme old age, no union is ever formed, the neck is generally wasted and surrounded with pus, and the head is joined to the shaft of the bone by ligamentous bands.

The ancients imagined that bones when fractured within the joints could never be reunited by bony union, as the ossific juice was kept perpetually diluted by the sinovia; and hence they conceived that a fracture of the neck of the thigh-bone was incurable. Mr J. Bell imagines that when the capsule is not torn, the fractured neck of the thigh-bone never reunites; and that it is only when the capsule is lacerated, and the sharp end of the shaft driven in amongst the muscles, that callus is formed. He conceives that it requires the bone to be surrounded with a mass of soft parts before it can form callus, and that these by inflaming, thickening, and adhering to the bone, contribute most esentially to its formation.* This seems to be the true explanation. Not only does the action of the soft parts in immediate contact with the fractured bone, materially assist in the formation of the callus, but the swelling which ensues presses upon the ends of the bones, and this with the consequent adhesion holds them in contact.† In fractures of the patella and olec-

* See John Bell's Principles of Surgery, p. 550. et seq. where this is well explained.

† The French surgeons of the present day, conceive that

cranon, where the bone is placed in the same circumstances with the neck of the thigh-bone, and free from the immediate contact of muscular parts, we uniformly find them healed by ligamentous and not by bony union.

FRACTURE OF THE PATELLA.

The patella is very liable to be broken. It may be fractured by a direct blow, as in falls, from the bone striking the ground or the edge of

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the neck of the thigh-bone, although fractured within the capsular ligament is reunited by ossific matter. The English surgeons, on the other hand, contend that no bony union ever takes place when the fracture is situated entirely within the ligament, if the capsule remains entire, and if the head of the bone be completely separated except at its connection by the round ligament with the socket. It is only in these circumstances that the English surgeons maintain this doctrine. They admit that bony union takes place when the fracture is external to the capsular ligament, or when the ligament is ruptured. In those cases of ossific union which I have seen, the capsule uniformly adhered to the bone, a sure proof that it had been lacerated at the time of the accident. The internal surface of the capsule, is a secreting surface, consequently could never adhere to the neck of the bone, unless extensively inflamed; and as the simple fracture of the bone would not inflame the capsule, it is probable that such inflammation as would produce adhesion, could only be induced by extensive laceration.

a step; but the accident most commonly happens from the sudden and strong action of the extensor muscles of the leg which are implanted into it. A man for instance, when falling backwards, makes a violent exertion to recover himself. The rectus muscle suddenly pulls up the patella, which instead of resting in the natural hollow of the joint, as it does when the leg is bent, and at rest, is now placed upon that ridge at the lower part of the thigh-bone which bounds the joint. The thigh-bone being here convex, and the patella also convex within, touch one another only at one point. Now the leg being half bent, the ligament of the tibia strongly retains the patella, at the moment the muscles pull it up, and while the bone is thus critically placed, the sudden muscular exertion made to recover the position snaps it across, and the man falls. The fracture precedes this event, and the noise of the bone giving way is heard before he reaches the ground.

The injury is easily detected. The patient falls down helpless; the extensor muscles retract the upper portion of the bone; by the continuity being destroyed, they have no command over the leg; and the patient therefore cannot extend it. In consequence of the retraction of the upper portion, there is an interstice betwixt it and the lower, perceptible both to the eye and touch; and when the two fractured portions are pressed together, a crepitus can be perceived; but still

there is in general little pain and very seldom any considerable inflammation.

In the treatment of this fracture, that the surgeon may be enabled to bring the separate portions of the bone into contact, he should extend the leg, and at the same time relax those msucles which are inserted into the patella. This is best accomplished by bending the pelvis upon the thigh, which is done by placing the patient in bed in a half sitting posture, inclining the head and trunk backwards. The surgeon then grasping the thigh, and carrying the same hand along its forepart towards the knee, brings down the upper portion of the fractured bone; while with the other hand he pushes up the lower portion, and thus places them in close contact. In order to secure them so, a roller, seven or eight yards long, should be passed round the lower part of the trunk and carried along the thigh. This not only assists most materially in keeping down the patella, but by its pressure lessens the tendency which the muscles attached to the bone have to contract. When the roller has nearly reached the knee, a compress of linen or cotton should be laid upon the place where the tendon of the rectus muscle is inserted; and the bandage should now be carried round the joint in the form of the figure of 8. This, if properly applied, the posture we have recommended being at the same time attended to, will effectually keep the ends of the bone in apposition.

To maintain the limb steady, a splint should be laid along the ham, extending from half way down the thigh to below the calf of the leg. From the manner in which the roller is carried round the joint, the knee-pan is left uncovered; which permits the surgeon to apply saturnine lotions, or leeches if needful, to repress any inflammation. But if the knee is inflamed and swollen before the surgeon is called, he ought not to apply any bandage till the inflammation and swelling are allayed by local bleeding, fomentations, saturnine applications or other means. If again any considerable inflammation and swelling supervene upon the application of the roller, it should be immediately removed and not reapplied till these symptoms have subsided. With the view of preventing a stiff joint, at the end of three weeks the bandage should be undone, and the limb gently and cautiously bent, the patella being kept down with the hand as already recommended in fracture of the olecranon. This practice should be repeated at the end of every two or three days, and the bandage reapplied, till the union is conceived sufficiently strong to admit of our intrusting the bone to the natural action of the muscles.

The patella is always reunited, after fracture, by a ligamentous substance, and never by ossific matter; but when the broken pieces are kept in close contact the patient has the complete use of the limb; whereas when the muscles are allowed

to contract and the pieces to remain at any distance from each other, he is always lame. He can walk tolerably well on level ground. He can also go down stairs, but he cannot go up, nor ascend a hill. The rectus and other muscles, which in their natural state extend the leg, have now shrunk in a degree equal to their whole power of contraction, and therefore cannot now extend the leg nor support the body. The patient frequently falls, and by his violent exertions to prevent his doing so, he is apt to break the other patella, and thus render himself almost entirely lame. It is therefore an object of the first importance to keep the fractured portions in as close contact as possible, as the patient must be lame in proportion as they remain separate. The bone is united by ligament, sometimes at the distance of half an inch, sometimes an inch and sometimes two inches; and if the accident were left to itself and the pieces allowed to remain as far separate as the retraction of the muscles placed them, still the ligamentous substance would be formed. In the splendid Museum in Windmill-Street I saw a patella which had been reunited by ligament at the distance of four inches, and in other collections I have often seen the pieces at the distance of one and two inches.

FRACTURE OF THE BONES OF THE LEG.

The tibia is frequently broken without the fibula; and the fibula is sometimes broken when the tibia remains entire; but both bones are more commonly broken together. Fracture of the tibia is discovered by running the finger along the shin, as the bone is here quite superficial; and more particularly by a crepitation upon moving the foot. In this case, however oblique the fracture may be, there is no retraction, as this is effectually prevented by the fibula. The fibula, from being the weaker bone, is more frequently fractured than the tibia. This accident occurs from direct blows or falls on the outside of the leg. The bone is often broken by the foot being turned or twisted in by a fall, and in this case it gives way a little above the ancle. Although the fibula is almost as superficial as the tibia, its fractures are not so easily detected, for the latter bone being entire the patient can stand, and in some cases even walk; but we are generally able to feel a hollow a little above the ancle, which happens from the upper end of the lower portion falling in towards the tibia. The foot is turned obliquely outwards, because the outer ancle yields; and there is a crepitation on moving the foot, with a sensation of pricking arising from the spiculæ of the bone. As the fibula in frac-

tures of the tibia prevents the shortening of the limb, in like manner does the tibia prevent retraction in fracture of the fibula, and hence the leg always remains of its former length.

When both bones are broken together, the fracture most commonly occurs near the middle of the leg. The nature of the injury is at once discoverd by the mobility of the foot; by distortion—the lower part of the limb generally falling away and the bones of the upper part projecting; by the inability to walk; by carrying the fingers along the bones; and by a crepitation.

When the tibia only is broken the fibula performs the office of a splint, preventing shortening of the limb, and keeping the ends of the broken bone in contact; but as the inner ancle yields the foot turns a little inwards. To prevent this inclination of the foot, is all that is required in the treatment. The surgeon should therefore take a long pasteboard splint, soak it in hot water and dip it in glue; and then bending the knee, he is to lay the leg on its outer side upon the splints, and fasten it by passing one ribbon or tape a little below the knee and another at the ancle.

In fracture of the fibula, the tibia in its turn performs the same office to that bone which it did to the tibia. It keeps the leg firm and of its proper length and as here the outer ancle yields so as to permit the foot to be turned obliquely outwards, all the care that is necessary is to turn the foot sufficiently inwards, and to keep it so

during the cure. By turning the foot inwards the lower portion of the broken bone is brought outwards, and the bone can never be too far raised as the interosseous ligament prevents it from rising above the level of the upper portion of the broken fibula. The surgeon should, as in fracture of the tibia, bend the knee and lay the leg on its outside upon a wet pasteboard splint. The splint must be so long as to embrace both the joints of the knee and ancle, extending to the sole of the foot, and having holes cut in it to receive these joints. After the splint has been fastened by circular tapes, the foot must be turned inwards and kept so by bolstering it up with compresses or tow.

When both bones of the leg are fractured, although there is generally distortion, and sometimes shortening of the limb, the extension does not require to be violent; the setting is easily effected, and most commonly the broken bones are easily retained. We employ two splints, and, for greater security, they should extend from above the knee to beyond the ancle. The surgeon takes a large pasteboard splint with two holes cut in it near its ends,—one for the knee, and one for the ancle; and having soaked in it hot water and dipped it in glue, as in the treatment of other fractures, he lays it upon the bed. He then bends the knee, employs that degree of extension which is necessary to bring the broken ends of the bones in contact,—and lays

the limb, on its outside, on the splint. After this he is to take another pasteboard splint of the same length, and after cutting similar holes in it for the knee and inner ancle, having soaked it, and besmeared it with glue, he applies it in like manner upon the inner side of the leg. He then tightens and firms the splints by four tapes, one passed round immediately above the knee, one immediately below that joint, one just above the ancle, and one about the middle of the leg. The last of these should not be applied upon the place of the fracture, but a little above it, or a little below it. The advantage of this kind of bandage is, that the surgeon can at any time, without disturbing the limb, remove the upper splint to ascertain the state of the bones.

Although gently bending the leg and placing it on its outer side be in general quite sufficient for every purpose in the management of fractures of both bones of this limb, still I conceive that, after applying the splints, a preferable treatment is to lay the leg upon the back, with the toes turned upwards, placing it in the machine recommended for fractures of the thigh. By this contrivance we can increase or diminish the flexure at the knee; we can augment the extension if necessary: and, by the support given to the back part of the leg, the lower portion is kept on a level, and prevented from falling or being pulled away from the upper portion. When the fibula is broken immediately above the ancle, the ma-

chine most effectually prevents the foot turning outwards, and keeps the lower portion of bone upon the same level with the upper portion. This it is enabled to effect by the surgeon fastening the foot to the foot-board, the sole of which is to be inclined inwards and set at an angle sufficient to raise the lower portion of bone, in which position it is retained by the screw.

FRACTURES OF THE TARSAL AND METATARSAL BONES, AND OF THE PHALANGES OF THE TOES.

Fractures of the bones of the foot and toes are generally produced by the fall of heavy bodies, by machinery, or by carriage wheels passing over the foot. In such cases there is in general great contusion of the soft parts, which is very apt to be followed by violent inflammation and gangrene. When there is much swelling, the state of the bones cannot be ascertained; but when this is not the case, a crepitation can be distinctly perceived. These fractures must be treated like fractures of the bones of the hand. The bones must be replaced as accurately as possible, and the foot laid out at rest upon a pillow; while the inflammation must be obviated or allayed by leeches, combined with warm opiate and saturnine fomentations.

CHAP. VIII.

DISEASES AND ACCIDENTS OF THE JOINTS.

GENERAL REMARKS ON THE STRUCTURE OF THE JOINTS.

The joints, with regard to their sensibility in health, and their proneness to disease, stand nearly in the same relation as the bones. Like them they are long of becoming diseased, the disease is slow in its progress, and, if not arrested at an early stage, there always follows the loss of the use of the joint, although it more frequently terminates in the death of the patient, unless prevented by the timely removal of the limb.

The extremities of the bones which form a joint are extremely spongy in their texture, and hence when they inflame they are very subject to caries. They are covered with smooth cartilages, which, although they have no vessels capable of transmitting red blood, are yet subject to inflammation and consequent erosion or ulceration. These cartilages are sorrounded by a capsule, which is composed of condensed cellular sub-

stance, and is a continuation of the periostium. This capsule is lined by a thin membrane, which is reflected over the articular cartilages, and is called the sinovial membrane. The reflection of this membrane over the articular cartilages is not very apparent in a state of health, but its continuity is very manifest in disease. When the sinovial membrane is inflamed, red vessels are seen ramifying in different directions over the surfaces of the cartilages, and these vessels assist in the increased secretion of fluid which always attends inflammation of the membrane.

The use of the capsule is rather to secrete and contain the sinovia than to retain the ends of the bones,—the strength of all joints depending chiefly upon the processes of the bones and the accessary ligaments.

From the capsule being formed of condensed cellular substance, and from the manner in which it is lined by the sinovial membrane, the outer surface is always rough, and it adheres to the lateral ligaments, the tendons of the muscles and the muscular aponeurosis; while the internal surface is smooth, wet, and shining like the inner surface of the pericardium or peritoneum, and is in its structure analogous to serous membrane. All the hinge joints are strengthened by lateral ligaments; in a joint that is exposed to violent actions there are also internal ligaments, as in the joints of the hip and knee; and where the motion is great, there are superadded moveable

cartilages to lessen the effects of friction. It is from this numerous complication of soft parts that the joints are so liable to disease.

SECTION I.

DISEASES OF THE JOINTS.

THE joints are subject to inflammation and its consequences, as suppuration, effusion, and ulceration. Sometimes the disease begins within the joint, and sometimes exterior to the capsule. The more numerous the ligaments, and the more complicated a joint in its structure, the more liable it is to disease; hence the knee-joint is more frequently diseased than any other joint of the body. Whatever the disease is, and whether it arises from an internal or external cause, it is, as in other structures, always preceded by inflammation; and if the constitution be sound the inflammation will be healthy, or it will assume the peculiar nature of the constitutional predisposition. If scrophula is present, white swelling, the most dangerous disease of the joints, is apt to succeed.

The chief disease of the joints are Inflammation, Dropsy, White Swelling, the Morbus Coxarius or Hip Disease, Anchylosis, and Loose Cartilages or extraneous bodies in their cavities.

INFLAMMATION OF THE JOINTS.

THAT species of inflammation of a joint which properly falls under the care of the surgeon most generally occurs in consequence of external injury. It is usually attended with severe pain, particularly upon motion; sometimes with redness of the skin; and always with more or less swelling. When the inflammation is slight, there follows an increased secretion into the cavity of the joint producing swelling from the effused fluid. When the inflammation is severe, suppuration and ulceration are apt to occur. These are always destructive to the structure of the joint. In the first stage of the inflammation, if violent, there is great pain generally accompanied by high symptomatic fever. In the second stage, when suppuration occurs, the cartilages covering the bones, the sinovial membrane, and the capsular ligament generally ulcerate; and the constitutional irritation is then so great that there immediately succeeds hectic fever. In this state of the parts the disease is apt to extend to the bones, which inflame and ulcerate. When there is no tendency to scrophula in the habit, the inflammation rarely terminates in suppuration and ulceration; but when this predisposition exists, it is apt to terminate in pure white

swelling, one of the most marked forms of scrophula.

The consequences of all inflammations are to be deduced from the natural delicacy of the organ and its importance in the system. In the inflammation of joints there is apt to follow dropsy, from the increased secretion of sinovia; also the formation of pus and ulceration, a thickening of the capsular ligament and other soft parts, with anchylosis.

Of all the joints, those of the knee and hip are peculiarly liable to inflammation. In bruises of the hip-joint, the pain is so violent, and the lameness which ensues so complete, that the accident has been confounded both with fracture and luxation; but there is this marked difference betwixt them, that when the joint is merely bruised, the patient can walk for some time after the injury, whereas in fracture or luxation he becomes instantly lame.

In consequence of a fall upon the great trochanter or the knee, the internal apparatus of the hip-joint is so bruised that it immediately inflames. When this takes place the pain is excruciating both day and night; the patient screams upon the slightest motion; and, when the inflammation rises high, neither bleeding nor opiates give the least relief. It is only time that allays the suffering. This accident frequently happens to elderly people, from their being more liable to falls; and they are long of recovering. It is

often five or six months before they can turn in bed, but at last the inflammation abates and the use of the joint is in general restored.

TREATMENT OF INFLAMED JOINTS.

In the management of inflamed joints, the most absolute rest should be enjoined; and recourse should be had both to topical and general blood-letting, proportioned to the severity of the local and constitutional symptoms. Topical bleeding is best effected by leeches, and they should be applied in much greater numbers than is generally done—their operation being promoted by fomenting the joint for a length of time with cloths steeped in warm water. The warm fomentations, independently of encouraging the bleeding, have a powerful effect in subduing the inflammation by the relaxation which they produce. After the joint has been freely bled, saturnine lotions are the best applications. They should be used warm and kept constantly applied. If the inflammation is slight they may be employed cold; but it will be found, in general, that warm applications are better suited to inflamed joints than cold.

It will be proper to apply the leeches again and again, should the severity of the symptoms require it; while we at the same time purge, keep the patient cool and quiet, place him on a

low diet; and have recourse to all those means recommended to obviate inflammation, more especially to general blood-letting, according to the degree of fever and strength of the patient.

After the inflammation has subsided, there commonly remains a considerable thickening of the capsule and other soft parts, frequently attended with effusion into the joint or surrounding bursæ, and sometimes accompanied with a slight degree of pain. When there is pain or increased sensibility these affections are best treated by the repeated application of blisters; but when there is no pain, their removal is most readily effected by compression, applied in the form recommended for the cure of dropsy of the joints.

When the structure of the joint is completely ruined by suppuration and ulceration, attended by wasting hectic fever, we are compelled to have recourse to amputation.

DROPSY OF THE JOINTS.

All the serous membranes have a natural exhalation, which, from a variety of causes, is apt to accumulate in a preternatural degree, forming various species of dropsy. We have already remarked that the membrane lining the capsules of the joints is of the same nature as the serous membranes; and from the same causes a preternatural quantity of fluid is frequently effused into

it. All the larger joints are subject to dropsy, but more especially the knee. The following observations therefore are applicable chiefly to that joint.

The disease generally succeeds inflammation, which often arises from cold or from the irritation produced by foreign bodies within the joint; but so far as I have observed, it most commonly follows an attack of rheumatism. The fluid is sometimes contained within the proper cavity of the joint, and sometimes confined to the bursæ, situated immediately above and below the joint. When the dropsy is confined to the bursæ, it is indicated by two circumscribed globular swellings, one situated under the tendons of the extensor muscles immediately above the patella, and the other under the ligament of that bone immediately below the joint. In this case there is no swelling at the sides of the knee-pan. When the fluid is contained in the joint, the swelling is more extensive, and the tumor is chiefly at the sides of the patella, which is raised up, but moveable. There is here an evident fluctuation communicating a distinct sensation when struck with the fingers; the fluid can be made, by pressure, to pass from one side of the joint to the other, under the patella; there is a degree of stiffness and weakness rather than pain; no change of colour of the skin occurs; and the swelling is sometimes larger and sometimes smaller, according to the different states of secretion and absorption.

TREATMENT OF DROPSY OF THE JOINTS.

Articular dropsy is for the most part, like hydrocele, a local disease, and is to be cured by local means. The remedies in general recommended are, frictions with volatile liniment, turpentines, camphorated mercurial ointment, camphorated spirits of wine, or the flesh brush with the occasional application of blisters. If the disease has not been of long standing, the continuance of these means is frequently efficacious, particularly the repeated application of blisters; but if the disease has subsisted for some time, they are inefficient, and we must resort to more powerful measures. When the swelling could not be discussed, Heister directed to make an opening into the joint, to evacuate the fluid. This practice has been followed by some of the moderns, and is particularly recommended by the French writers; but it is fraught with the greatest danger. Cases are no doubt recorded, where large quantities of fluid have been evacuated by puncture, and a cure effected; but the joint is very apt to inflame, and I know that instances have occurred, where this practice has proved fatal; so that I am inclined to imagine that in the majority of the cases where openings are said to have been made into the joint, they were merely into the bursæ. Even if puncturing the proper cavity of the joint

was attended with no danger, still there is every reason to believe that merely evacuating the water would seldom effect a cure, as it would immediately collect again; and if means were had recourse to in order to prevent this, as by injection, there would follow such a degree of inflammation as would endanger the limb, if not the life of the patient.

Dropsies of the joints may be always cured by compression. By this alone we may in twenty-four hours frequently effect more than in months of successive frictions and blistering. I have in the course of eight days completely dispelled a dropsy of the knee-joint by means of compression, where blisters and frictions had been tried for three months without success. Compression is best applied by means of large pieces of dry sponge and a roller. In the knee, for example, we take two large dry sponges and lay one upon each side of the joint. If the dropsy be in the bursæ, we place one above the patella and the other immediately below it. We then apply a roller beginning at the ancle, carrying it to the points of the toes, and then returning upon the limb, with a moderate degree of tightness till we arrive at the knee, where we increase the compression over the sponges; we then carry it more loosely up the thigh, and end at the groin. The bandage should be applied anew every morning and evening, as it gradually becomes slacker. The swelling in general rapidly disappears and is

completely gone in the course of a few days; but the bandage should be continued for some time after the swelling has entirely disappeared, although not with the same degree of tightness as during the existence of the disease. Its use should be now conjoined with cold bathing, to complete the cure. If the joint is much swelled the compression will at first no doubt produce pain; but in every successive application of the roller, the pain will diminish till it entirely disappears.

In whatever joint the dropsy is situated, the compression, by means of the bandage and sponge, must be applied in a similar manner as in the knee.

WHITE SWELLING.

True white swelling of the joints is a pure scrophulous disease, and the most fatal form under which it presents itself in this country. Like those of other scrophulous diseases, the attacks of white swelling are confined to the period of youth; and it seldom appears after the twenty-fifth year, unless the patient has formerly been afflicted with scrophulous affections of the glands. The joints of the elbow, knee, wrist, and ancles, are the most common seat of this disease, particularly the two former; but the knee is more frequently affected than all the other joints put together.

The first symptom in this case is generally pain, attended with such a degree of debility as to make the patient faulter in walking; sometimes the pain is superficial, and sometimes deep; sometimes it extends over the whole joint, but, more commonly it is confined to one spot, and becomes diffused in the progress of the disease. When the pain is deep-seated, it is sometimes felt in the centre of the joint, but most frequently in the head of the tibia. The pain is in some cases acute, and in others dull; but is always more severely felt when the patient becomes heated in bed. Sometimes the swelling precedes the pain, but the pain more commonly precedes the swelling; and, in some cases, even exists for a considerable time before any enlargement of the joint is perceived. When the swelling does appear, it soon acquires a firm, springy, and elastic feel, and does not pit upon pressure, like an edematous swelling. It is situated on both sides of the joint, but particularly on the knob of the tibia. The skin retains its natural colour, though the swelling advances. The joint becomes tightened and stiff, and, when much swelled, the skin acquires a glossy appearance, and is streaked with blue veins. Sometimes there is so much sensibility, that the joint feels hot, and is painful to the touch; but most commonly there is little pain upon handling it. This difference of sensibility is so striking, as to justify the division of white swelling into acute and chronic. In the progress of the disease, the thigh and leg shrink, and, from the

wasting of the limb above and below the joint, the tumor of the knee becomes more distinctly marked. The knee stiffens, and swells more and more; the inguinal lymphatic glands often become enlarged; and the pain is much increased by walking, and by the heat of the bed. In many cases, the knee inclines inwards, the leg and heel turn outwards, and thus the limb becomes much distorted. In this stage, the integuments, in general, adhere to the joint, and become quite puffy, and the excruciating pain night and day exhausts the patient. Walking is now very painful; the patient is unable to bear the weight of the body upon the limb; he only points the toes to the ground; and, from the bent situation in which he keeps the knee, the hamstring muscles contract, and the limb becomes fixed in this position.

By a careful examination, upon moving the joint, there will perhaps be felt a grating, which indicates an erosion of the articular cartilages, and with this there is frequently combined caries of the bones. After this, the sinovial membrane soon ulcerates; the integuments burst in one or more places; a crude and ichorous matter is discharged, and various sinuses are formed, which communicate with the cavity of the joint. The matter collected within the joint, or discharged by the sinuses, abounds with curdly flakes, like the contents of other scrophulous abscesses; but if there is much inflammation, it is fetid and bloody; and

when a probe is introduced, the bones can frequently be felt carious, sometimes even to such a degree, as to permit the point of the instrument to be pushed into their substance. The disease now rapidly advances, racking pain supervenes, with restless nights, confirmed hectic sweats, diarrhœa, emaciation, and great weakness, which soon terminate in death. But frequently the patient, after becoming hectic, dies without ulceration of the sinovial membrane, capsule of the joint, or integuments. In these cases, the cartilages are found to be eroded, and the bones carious, and there is matter in the joint.

There are two species of white swelling, denominated by systematic writers Rheumatic and Scrophulous. The former commences exterior to the joint, and the latter within the joint itself. They are both purely scrophulous diseases, although the former has been improperly ascribed to rheumatism. The only difference betwixt them is, that the one, which begins in the soft parts exterior to the joint, is always the more manageable disease. It is distinguished from the more inveterate, by the pain being not only less violent, but more diffused and superficial, and by a puffy and elastic feel, which is so peculiar, that the inexperienced practitioner is apt to believe that the tumor contains pus, or some other fluid. In this species, although the swelling is considerable during life, it shrinks so much after death as rarely

to exceed, except in a small degree, the size of the sound joint.

When the disease begins within the joint, the pain is always deep-seated, is confined to one spot, is very severe, and, for a considerable time, precedes the swelling. In this case, it commences in the bones, the cartilages soon inflame, and ulcerate, the sinovial membrane thickens, the capsule becomes cartilaginous, the ligaments also thicken, the cellular substance contains a glary fluid, and the whole feels as if the heads of the bones were enlarged, which however is but seldom the case. The older surgeons, who attended but little to dissection, imagined that in this disease the heads of the bones were always enlarged; the moderns again, who have more particularly attended to pathological anatomy, have rarely found them so; and hence they have denied that they are ever enlarged. The truth seems to lie betwixt these two opinions: for every one extensively engaged in the dissection of morbid bodies, must have occasionally found the heads of the bones enlarged in white swelling, and this is particularly apt to be the case, when the disease begins within the joint.

TMENT OF WHITE SWELLING.

ent of white swelling must vary ac-
and state of the disease—

whether it has been of long or short duration—and whether it presents itself under an acute, or a chronic form.

When the disease is in its commencement and acute, that is when it is attended with much pain on handling, increased heat or tenderness of the surface, recourse should be had to local blood-letting by means of leeches, or by cupping and scarifying. In some instances blood may be even advantageously abstracted from the general system; although in general it will be better to take it from the affected joint as operating more directly on the seat of the disease.

To be of ultility, the quantity of blood locally abstracted should be pretty considerable, perhaps to the extent of fifteen or sixteen ounces, and, if necessary, the bleeding should be repeated again and again at short intervals.

Its use should be combined with warm opiate and saturnine fomentations applied at least four times a day, half an hour each time, at the same time administering repeated saline cathartics. While we have recourse to these measures we should enjoin the most absolute rest. If the disease is situated in the knee, the limb should be placed in an extended position and moved as little as possible.

This attention to rest should be strictly kept in view, not only in the inflammatory, but in all periods of the disease. In the inflammatory stage it tends greatly to alleviate the inflammation, and in

the stage of suppuration and ulceration, it contributes powerfully to the termination of the disease, by favouring anchylosis. As soon as the heat, increased sensibility, and other marks of acute inflammation are gone, we change our treatment. The generality of topical applications, as soap liniment, anodyne liniment, camphorated oil, camphorated spirits of wine, camphorated mercurial ointment, turpentines, poultices, sea bathing, the pumping of warm water, and electricity are inert; they have never cured this disease; and they are therefore not only unworthy of our notice, but so far pernicious as they prevent us from employing more potent remedies.

Whatever excites external inflammation lessens internal vascular action. It seems to be upon this principle that caustic issues and blisters operate in this disease; and they should be had recourse to early, as the only remedies in which we can place any confidence.

Blistering, to be of service, should be frequently repeated. A blister should be laid on one side of the joint from which a discharge may be kept up for ten or twelve days. At the end of this time it will be better to allow it to heal and apply another blister to the opposite side of the joint, than to continue the discharge from the first, as in this case the external irritation is less than when the blister is renewed, because there is a perpetual secretion of new cuticle which de-

fends the true skin from the irritating effects of the issue ointment, and consequently lessens the external action. The blister may be kept open either by means of the ointment of Spanish flies or savine ointment. The former of these sometimes excites great constitutional irritation, and produces stranguary; the latter has no such effects, and is on that account preferable, more especially when applied to a surface of great extent. By successive blistering conjoined with rest, the pain frequently subsides, the action abates and a cure is effected; but the blisters should never be applied where there is the least increased external sensibility, as I have observed that when this is the case they uniformly aggravate the symptoms. Their use is only applicable to those cases where the pain is deep-seated, and where there is no increased heat or action of the surface, and when these symptoms are present, it should be preceded by local bleeding and warm fomentations.

In the treatment of white swelling, the frequent introduction of caustic issues appears to me to be preferable to repeated blistering; and although we introduce peas, to promote a discharge, yet the good effects produced by the caustic issue seem to depend more on the external inflammation and irritation which it excites than on the discharge. A caustic issue should be introduced first at the inner and lower part of the joint upon the top of the tibia; and may be formed either by applying a portion of powdered argentum nitratum

upon a piece of lint, and retaining it for ten or twelve hours by means of adhesive plaster, or by dipping a piece of potassa cum calce in water and rubbing it on the surface till an eschar is formed. When we form the issue by allowing the caustic to remain applied, the argentum nitratum is preferable to the potassa cum calce, as it is not so apt to spread. To prevent this effect we first apply a piece of adhesive plaster with a hole cut in its centre the size of the issue we mean to form; we then lay upon this opening a little lint covered with the powdered caustic; and, to retain all, we apply another piece of adhesive plaster above it, and secure it by means of a few turns with a roller:—in the knee and in those joints where the bones are thinly covered, the preferable practice is to form the issue by rubbing the caustic upon the part, as there is some danger of it penetrating too deep and rendering the bone carious. For this reason all issues should be formed either above or below a joint, in such a situation as not to endanger an opening into its cavity.

As soon as the eschar is formed, a warm poultice should be applied and renewed three times a day till the slough separates, when an irritation is to be excited and a discharge promoted by the introduction of a few peas. After the discharge has been kept up for a fortnight or three weeks, the peas should be withdrawn and the sore allowed to heal. At this time another caustic should be applied to the opposite side of the joint, and the

issue treated in a similar manner, at the same time applying a succession of blisters over every accessible part of the joint. While this treatment is pursued, we must be particularly careful to keep the leg extended, otherwise from the pain of the issues and the continuing in bed, the patient will draw it up, the hamstring muscles will contract, and the limb will become permanently bent.

When there is no increased heat of the surface, and when the general sensibility is gone, when there is little pain in the joint, and when the swelling has an elastic and springy feel, manifest advantage may be derived from compression.

We remarked the great use of compression in dropsy of the joints; it will be equally efficacious in this state of white swelling. If there is no increased sensibility to prevent it, we may, by the force of pressure, obliterate any tumour, and even the very bones. When the disease is therefore in a complete chronic state, the sponges and roller should be applied as recommended in dropsy of the joints.

When the tumour has suppurated and ulcerated, and when there is a discharge of matter, we adopt that part of the foregoing treatment which is best suited to the state of the disease; but when the discharge is profuse, and when the joint is destroyed, attended by extreme debility, quick pulse, night sweats and other symptoms of hectic, our only resource is amputation; and the low state of the patient is rather favourable to the success of

the operation. But let it be remembered, that in whatever state the joint is, amputation should never be resorted to nor even thought of, till the constitution begins to suffer so much as to endanger life, or to irretrievably ruin the health; for when the joint has suppurated, and even when the cartilages have been eroded, and the bones become carious, attended with considerable constitutional irritation, the local action has ceased, the fever has abated, and a cure has been effected by anchylosis—the limb having been kept at rest.

MORBUS COXARIUS OR HIP-DISEASE.

The morbus coxarius is a scrophulous disease nearly allied to white swelling. It most commonly makes its attacks, without any apparent cause, before the age of puberty; but the disease is not necessarily confined to youth, as it sometimes occurs in middle life and even in old age, in which cases it can be most commonly traced to a blow. Like other scrophulous affections of the bones, it is of such an insidious nature that in general it has made considerable progress before it is observed, as it is apt to be mistaken either for growing pains or rheumatism. The patient for a long time complains only of a weakness and weariness of the limb, attended with a slight halt in walking and a particular uneasiness about the knee. There is at this time so little pain in the hip-joint, that

the disease has been frequently mistaken for some affection of the knee. But if the diseased limb be compared with the sound one, it will be found much emaciated and considerably lengthened. By the thickening of the soft parts within the joint, in consequence of the inflammation, the head of the bone will be raised to a certain extent from the socket, and this might at first sight seem to account for the elongation of the limb; but we shall soon find that this cause is inadequate, as the limb is frequently lengthened to the extent of some inches.

Mr Hunter ascribes the lengthening of the limb to the diseased side of the pelvis falling lower than the other, and upon a careful examination, the tuberosity of the ischium will be found to be situated lower than that of the opposite side. This is always the case when the elongation prevails to a marked extent, and can only be ascribable to the oblique position in which the patient places his body in throwing the weight on the sound leg, which he always does as he is unable to bear any pressure on the diseased limb. Although the patient, in this incipient stage of the disease, actually complains of more pain in the knee than in the hip-joint, it will be perceived that the pain in the knee is not increased upon motion: whereas, if the acetabulum be pressed upon, or the joint rudely handled, the pain in it is exquisite. If the nates be examined after the disease has made a little more progress,

that of the affected side will be found to be larger, to have lost its natural roundness, and to have acquired a flattened form, all arising from the increased size of the joint, and from the emaciation of the glutæi muscles. When the disease has arrived at this stage, there is considerable pain, on the joint being pressed upon, particularly on the fore part a little below the groin, and towards the outside of the thigh, where the joint is more superficial

At this period of the disease, the lymphatic inguinal glands, as in white swelling of the knee, are sometimes enlarged.

This series of symptoms characterizes the inflammatory stage of the disease.

The second stage, is that which is accompanied by or terminates in suppuration, and takes place with greater or less rapidity, according to the activity of the inflammation. When suppuration ensues, the disease generally terminates in one of two ways. Either, after the suppuration is established, the head of the thigh bone and the acetabulum being carious, an anchylosis takes place without the matter pointing externally; or the sinovial membrane and capsular ligament ulcerating, the soft parts surrounding the joint, inflaming; swelling, and forming an abscess, the matter bursts out externally, and a serous fluid is discharged, mixed with curdy flakes. Not unfrequently in this case, the patient dies, exhausted by the profuse discharge and hectic fever.

From the great irritation which accompanies diseases of the joints, hectic fever sometimes appears early ; but its symptoms are most obvious after the formation of matter, and are always greatly increased when the abscess bursts, or is opened by art. When the inflammation within the joint is increasing and running on to suppuration, the pain becomes very acute; the patient is hot and restless during the night; he starts in his sleep; and when the limb is attempted to be moved, he screams in agony.

In the secondary stage of the disease when it has terminated in suppuration, there takes place a remarkable retraction or shortening of the limb. The head of the bone is now plainly out of the socket, and in consequence of the destruction of the cartilages, ligaments, and bone forming the acetabulum, the muscles, more especially those which are implanted into the trochanters, retract the bone and shorten the limb to a considerable extent. When the disease has been of long duration, not only all the soft parts immediately connected with the joint are destroyed, but the caries destroying the acetabulum, penetrates deep into the bones of the pelvis, attacks the head of the femur, and even extends to its neck.

I believe that this disease, like true white swelling, always originates in the bones; and it has been found upon dissection, that it generally, if not always, commences in the acetabulum. The cartilages soon inflame and ulcerate, the articu-

lar cavity soon becomes carious, and, in the progress of the disease, the caries extends to the head of the os femoris. The Morbus Coxarius, by an inexperienced practitioner, might be mistaken in the stage of suppuration for lumber abscess; but it may always be distinguished by the wasting and shortening of the limb, by the enlargement and flatness of the hip, and by the pain in the site of the joint, which is aggravated on pressure or motion.

TREATMENT OF MORBUS COXARIUS.

Amongst the ancients from the time of the Arabian Physicians, the actual and potential cauteries were much employed for the cure of pains of the bones and diseases of the joints; and by them, therefore, this affection was treated much in the same manner as it is now. In the early stage of the disease, it has been proposed to employ fomentations, the Bath water, blistering, cupping, and topical bloodletting; but there is nothing we can place any dependence on except the caustic issue. Perhaps blistering and topical bloodletting conjoined with rest, may have some effect when employed very early; and where there is evidently much acute inflammation, the application of leeches with warm fomentations is highly proper. But we should never waste time on trifling and insignificant remedies, when

we can employ the caustic issue, which the concurring testimony of the ancients and moderns declares to be the only efficacious remedy in this disease. It is useful at all periods of the disease, and when employed early, before the suppurative stage commences, it never fails to effect a perfect cure. Even when suppuration had taken place and the pain was exquisitely acute, I have known the caustic give such relief, that the patient was able to sleep sound, the night of its application, although the pain of the disease had prevented him from doing so for many weeks. The caustic issue seems to act not so much by the discharge it produces, as by the external irritation it excites, by which the internal inflammation is relieved, or a state induced favourable to anchylosis. The issue should be large and frequently renewed; its use ought to be persevered in for a length of time; and during its employment the limb should be kept completly at rest by confining the patient to a couch. If the joint has suppurated or become carious, the limb ought to be kept extended, because, should it anchylose, the extended position is the most serviceable in which the limb can be fixed. The place most favourable for the introduction of the issue, is the hollow immediately behind and below the great trochanter. While we pursue these local means, the constitutional treatment in the advanced stage of the disease, should be the same as in lumbar abscess—opiates to mitigate pain, diluted sulphuric acid to

restrain hectic sweats, and bark, wine, and generous diet to support the strength.

ANCHYLOSIS.

ANCHYLOSIS is the union of the extremities of two or more bones, which were originally intended to be moveable in the joint, and is a process frequently employed by nature to cure carious and diseased joints. It also often occurs in joints which are otherwise sound, and may arise either from the bones being joined together by ossific matter, or by the contraction of the tendons and ligaments surrounding and connecting the joint. This affection more frequently occurs in advanced age than in early life, particularly in the spine and in the articulation of the ribs with the vertebræ. When the anchylosis is formed by bony union, the disease is said to be complete, and when it occurs in consequence of contraction of the ligaments and tendons, it is termed incomplete.

In early life, anchylosis is very seldom an original affection, but is generally the consequence of some other disease. Hence, when it occurs in young subjects, it arises from inflammation of the sinovial membrane covering the articular cartilages; from eroded cartilages and carious bones, as in white swelling; from rheumatism attended by effusions into the bursæ and joints; from luxations

which have remained long unreduced; from fractures which involve the joint, or are situated near it; and from wounds of the capsular ligament; in fact, whatever disease of a joint excites ulceration of the cartilages, and renders the bones carious, will induce anchylosis. It occurs however, more frequently in consequence of white swelling, than from all the other causes which I have enumerated. When anchylosis takes place in old age, it arises from the ossification of the ligaments and cartilages of the joint.

TREATMENT OF ANCHYLOSIS.

When the articular surfaces are joined by ossific matter, and the anchylosis is complete, the disease is incurable, and indeed any attempt made to cure it would be productive of danger. Besides, when anchylosis is consequent upon ulcerated and carious joints, it can hardly be viewed in the light of disease, and nothing should be done to retard or prevent its formation, as it is a very desirable termination to the diseases of suppurating and carious joints. In the advanced stage of white swelling and other articular diseases, when the irritation abates and the discharge lessens, as there is a chance of the disease being cured by anchylosis, the limb should be so placed, as that in the event of this mode of cure being accomplished, it may prove most serviceable to the pa-

tient. This is effected by extending the joints of the lower extremity, and placing those of the upper in a state of semiflexion.

When the anchylosis is incomplete, and depends upon a contraction of the ligaments and tendons, it is in general easily cured, even although the disease has been of long duration. In this state of a joint, all that is requisite, is to move it gently and steadily from day to day, increasing the motion and extending the ligaments and tendons more and more, as the flexibility increases. Various medicated baths, embrocations and liniments, have been recommended for the cure of imperfect anchylosis; but the chief virtue resides in the friction and movement of the joint, and not in the applications. By bathing the anchylosed joint with hot water, at the same time rubbing it with soap and moving it gently backwards and forwards three times a day, half an hour each time, we shall almost always succeed in curing the disease when resident in the ligaments and tendons; or, instead of the hot water and soap, olive oil or axunge may be used in the friction, which is more easily managed, and is a preferable practice.*

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* A very remarkable case of Anchylosis is detailed in the eighth volume of the abridgment of the Philosophical Transactions. The skeleton was preserved in Trinity College, Dublin. Two drawings representing a front and back view, were taken of it by Dr. Ramsay, lecturer on Anatomy and Physiology, from which engravings were published.

There is an Anchylosed skeleton in the Museum of the Col-

LOOSE CARTILAGES IN THE JOINTS.

Loose cartilaginous substances have frequently been found in all the joints of the human body, but they occur most frequently in the knee. Upon a superficial examination, we might be led to imagine, that these extraneous bodies in the knee joint were nothing but the semilunar cartilages broke loose from their attachments; but this cannot be the case, as the same phenomena have occurred in the elbow, ancle, and many other joints; although it is only in the knee, that they arrest our attention and require our interference, from their frequently slipping betwixt the ends of the bones and producing lameness and exquisite pain. They are in general of the size of a small almond, and frequently less; but I have seen them nearly as large as the thumb. Sometimes there is but one of these bodies present in the joint, sometimes there are two or three, on other occasions there have been several, but in general their number does not exceed one or two. It is only when they get betwixt the bones that

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lege of Surgeons of London, similar to the above, but more remarkable, as belonging to a subject in the meridian of life; while that in Trinity College was the skeleton of a man far advanced in years.

they are productive of distress, and then they cause instant lameness.

The complaint is generally unattended with any swelling or discoloration, and the patient feels no inconvenience except when the foreign body gets betwixt the articular surfaces, when it produces instant lameness and pain; and this, when it frequently occurs, is followed by a degree of inflammation, which requires several days rest to remove. At other times there is a fullness about the joint, with stiffness and slight dropsical effusion, particularly after much exercise, and when the patient has been annoyed by the foreign body getting betwixt the bones. When this is large, it produces comparatively speaking little inconvenience, for then it is not so apt to slip betwixt the head of the tibia and the condyles of the femur.

The formation of the foreign body is always preceded by inflammation in the cavity of the joint, which generally can be traced to some external injury, although on other occasions this inflammation is the consequence of rheumatism, and the appearance of the extraneous substance soon follows the accident, or rather the inflammation induced by it. During the inflammation, an effusion of coagulating lymph takes place from the sinovial membrane covering the articular surfaces; into this, vessels shoot by which it becomes organized; and as the action of all secreting vessels forms a structure analogous to that from which

they originate, it soon assumes the nature of cartilage, and sometimes of bone, or of both.

This seems to be the most rational way of accounting for the occasional appearance of preternatural cartilaginous substances in the joints. It has been observed that they are sometimes attached, and sometimes loose; but it is evident that they must at the first have been attached by means of those vessels by which they are formed, and that in consequence of some accident, the attachment has been broken, and the body become disengaged.

These foreign bodies are smooth and polished; they generally have a convex and concave surface, formed by the action of the joint while they are yet soft; and, upon being cut into, they are found to be partly cartilaginous, and partly osseous.

The more frequent formation of these cartilaginous substances in the knee than in any other joint, does not depend upon any peculiarity in the structure of this joint, but arises from the knee being frequently exposed to falls, twists, and other accidents, by which the inflammation that engenders them is excited.

TREATMENT OF LOOSE CARTILAGES IN THE JOINTS.

It must at once appear, that the only radical cure for preternatural substances in the joints, is to cut them out; but openings into the joints, es-

pecially so large a joint as the knee, is not without danger, from the inflammation which is apt to ensue. I must not conceal that Home, Abernethy, and some other surgeons have cut these bodies out of the knee joint with success; nevertheless, in such a case I should not venture to operate, unless compelled by the most urgent necessity. I should rather, with a view to confine the foreign body to one situation, and to prevent it from slipping betwixt the bones, have recourse to a tight roller, or a laced knee pan, as recommended by Mr. Hey of Leeds. Mr Hey, a great practical surgeon, was so afraid, from what he had seen, to make openings into joints, that he recommends a bandage to be kept tightly laced round the knee; and he says that as long as this bandage was worn, the patient was able to support his complaint.

If the patient is in that rank of life that his complaint interferes with his daily occupation, or if he insists on an operation, the joint should always be cut into, on the inside of the knee, because the extraneous body can be pushed higher above its original seat on that side, than it can be on the other; and in performing it, we ought to take care that the wound in the integuments does not correspond with that in the capsular ligament. The operation can be performed only when the foreign body can be brought to present at the inside of the knee. This opportunity therefore must be watched for, and when it occurs, an assistant

should grasp the loose cartilage betwixt his finger and thumb, and fix it by pressing high upon the inner condyle, while the surgeon pulls the integuments towards the inside. He should then make a longitudinal incision, in the extended state of the limb, directly upon the substance, and so as to admit of its being easily forced out. After the cartilage has been expelled by the pressure of the fingers, or hooked out by a tenaculum, if the integuments are let go, they will immediately retract and cover the wound in the capsule. The edges of the wound are to be kept in contact by adhesive or black court plaster; the limb is to be immoveably fixed in the extended position; and any rising inflammation must be repressed by saturnine lotions and leeching. Previous to the operation bloodletting, cathartics, and low diet should be enjoined; and after it, the most absolute rest is necessary to obviate inflammation and ensure adhesion.

SECTION II.

ACCIDENTS OF THE JOINTS.

THE joints are liable to partial injury, but the accident which most frequently calls for the interposition of the surgeon is luxation; and this, like fracture, may be either simple or compound. In the former, the bones constituting the joint are

simply displaced, and although when not reduced, the injury may occasion lameness, it never, at least in the extremities, hazards the life of the patient; whereas, when the luxation is compound or complicated with a corresponding wound of the integuments, it not unfrequently produces death, even under the best treatment.

SPRAINS.

A sprain is the violent stretching of the ligaments, and all the other soft parts connected with or surrounding a joint. In consequence of external injury, the connecting ligaments of the bones are forcibly distended and sometimes ruptured; the tendons of the muscles which are implanted in the immediate neighbourhood are wrenched; the muscular aponeurosis which binds the joint is extended; the nerves, blood vessels, and skin are violently stretched, so as to injure their structure; and the subcutaneous veins are not unfrequently burst, giving rise to extensive ecchymosis.

Sprain is nearly allied to luxation, the distinction betwixt the two consisting in this, that in sprain the ligaments are forcibly stretched and sometimes torn, which accident is followed by inflammation and loss of power; whereas, in luxation, they are completely burst up, and the heads of the bones are displaced.

The same parts are injured in sprain as in luxa-

tion, and the former is to all appearance a less dangerous accident than the latter; yet sprain is often as injurious to the structure of a joint, and as fatal in its consequences—not unfrequently ending in anchylosis, or sometimes giving rise to extensive inflammation, which terminates in gangrene and death.

The joints most liable to sprain, are those that admit only of flexion and extension, and are strengthened by lateral ligaments. Of these the most frequently injured in this manner, are the ancle and wrist, which arises from their greater exposure. A sprain of either of these joints is always a troublesome accident, in consequence of their numerous complication of ligaments. The first effect of the injury is swelling, in consequence of blood effused from the ruptured veins; the second is inflammation, in consequence of the forcible stretching of all the soft parts; and the third effect is weakness or want of power in the joint, in consequence of the loss of tone in the ligaments and tendons of the muscles. When the sprain is slight, there is little inflammation and little pain, except on motion, and any swelling which occurs, immediately follows the accident, and arises from the blood effused from the ruptured veins. The skin in the neighbourhood of the joint is discoloured from this effusion of blood, which, like ecchymosis in other parts, gradually becomes of a lighter shade, changing from black to yellow, and at length entirely disappear-

ing. When the ligaments are torn the joint requires a great length of time to recover.

Sprain may always be sufficiently distinguished from luxation, not only by manual examination, and by the form of the joint, but by the patient being always able to use the joint to a greater or less extent immediately after the accident; whereas, in luxation it is from the first immoveable. This last mark, however, can be depended on, only for a short time after the accident, as in a few hours, the swelling and pain prevent the patient from using the joint in the least degree.

TREATMENT OF SPRAINS.

There is no injury in which a speedy cure and a complete command of the function of the part depend more upon attention in the treatment, than in that of sprain. Patients finding that they can walk immediately after it, persist in doing so as long as they are able; by which such a degree of inflammation and swelling frequently succeed as to endanger the limb. The first point, therefore, to be attended to in the treatment of sprain, is to keep the limb in a state of rest, which should be particularly enforced, however slight the accident may be, and put in practice as early after its occurrence as possible. This may either prevent the accession of inflammation, or repress it if it has already taken place. The parts should

be freely blooded by leeches, and the number applied should be much more considerable than what is commonly used. Thus, instead of employing a few leeches, which can be of little service in a case of this nature, from twelve to eighteen should be placed all round the joint, and the bleeding promoted by immersing the parts in warm water, or what is preferable, in a warm solution of opium and the acetate of lead. This, while it promotes the bleeding, has a greater tendency to repress the inflammation and afford relief than the warm water. No harm can possibly arise from free bleeding, and as it tends greatly to prevent or abate the inflammation, to lessen the pain, shorten the period of confinement and save the joint, it should always be had recourse to. The leeches should therefore be repeated according to the urgency of the symptoms, and their use persevered in till the inflammation is completely subdued. While we adopt this mode of procedure with regard to bleeding, the parts should be fomented or immersed in the opiate and saturnine solution, three or four times in the twenty-four hours, for at least two hours each time,—covering them in the interval with cloths dipt in the solution heated. It will be found, that this practice of free-bleeding and fomenting will abate the inflammation sooner than any other mode which can be adopted. As soon as the acute state of the inflammation is gone, and the patient can permit the joint to be handled, all

further bleeding and fomenting should be laid aside, and the parts gently rubbed every four or five hours with camphorated spirits of wine, or with the anodyne liniment. This treatment will soon entirely remove all remaining inflammation and pain, but the joint sometimes continues long feeble, owing to a loss of tone in the ligaments and tendons of the muscles. This state of weakness is best counteracted by cold bathing, and the application of a roller.

LUXATIONS.

GENERAL OBSERVATIONS ON LUXATIONS.

A luxation is the displacement of a bone from its articular cavity. When this accident occurs in consequence of external injury, there is always a complete laceration of the capsular ligament,—a laceration also to a greater or smaller extent, of the lateral or peculiar ligaments, and sometimes of those muscles which are implanted near the head of the displaced bone,—and not unfrequently fracture.

All the joints of the body are liable to be occasionally luxated, although it requires a greater degree of violence to luxate some joints than others. The orbicular joints, or those which consist of ball and socket, are the most easily displaced, and the facility with which they are luxated

generally renders the luxation complete. The hinge joints are luxated with more difficulty, and hence their articular surfaces are rarely so entirely displaced as to form a complete dislocation. When there are projecting points of bone, as in the ancle, there can be no lateral luxation without a fracture.

The orbicular joints possess a greater range of motion than the hinge joints, and are therefore more liable to be displaced. In the hinge joints, which admit only of flexion and extension, luxation is more rare. Independently of the security of lateral ligaments, the bones frequently lock into each other, as in the elbow and ancle; and hence it requires great force to luxate them. Where a hinge joint is not thus guarded by bony processes, as the knee, the joint is protected by numerous and strong ligaments; the knee therefore, although very subject to disease, is rarely luxated.

The marks which characterize luxation, are distortion, pain, inability to move the injured limb, a fixed state of the joint, and a lengthening or shortening of the limb. The nature of the accident may be detected also by manual examination. Although some of the symptoms now enumerated be present in fracture, yet when taken collectively, they always sufficiently point out luxation. Distortion is no doubt an attendant upon fracture, as well as luxation; pain and inability to move the limb also accompany fracture and extensive contusion;

but a fixed state of the joint, with great pain upon attempting to move the limb, and a lengthening or shortening of it, conjoined with what is discoverable on manual examination, will always lead us to distinguish luxation from all other accidents. In all the luxations which I have seen, the head of the bone was so locked or fixed, that the limb was much circumscribed in its motions, or rendered nearly immoveable; whereas in fracture, it can be freely moved in all directions. As an exception however to this remark, it may be stated that a case occured to Mr Astley Cooper, where, although the head of the thigh-bone was lodged in the thyroid hole, the limb could be moved with great freedom immediately after the accident; in the course of three hours, the head of the bone became firmly fixed by the action of the muscles, by which the limb was rendered immoveable*.

When the articular surface of a bone is displaced, the limb is either lengthened or shortened, according to the nature of the luxation. Thus in luxation of the thigh upwards and backwards, when the head rests upon the dorsum ilii, the limb is shortened; while when the head of the os femoris is lodged upon the muscles of the obturator hole, it is lengthened. This [illegible]

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* Vide Ser[illegible] M[illegible] Cooper[illegible]

tion in the length of a limb, invariably follows every species of luxation. When there does not exist much swelling in the neighbourhood of the injured joint, the surgeon, by careful manual examination, will most commonly be able in luxation to feel the articular cavity empty, and the head of the displaced bone lodged in its immediate vicinity. As the future comfort and happiness of the patient depend upon the surgeon's ascertaining the exact nature of the injury, the discriminating symptoms betwixt fracture, sprain, and luxation, should be deliberately weighed, in order, if possible, to prevent the confounding the nature of an accident, which at an early stage may be easily remedied, but which, after the lapse of a short time, it is beyond the reach of his art to rectify.

The capsular ligament is so very weak, that it is little security against luxation, and seems more intended to contain the sinovia than to protect the joint. The chief securities are the form of the joint with regard to its bones, its peculiar ligaments, and the tendons of the muscles implanted round it. Though the muscles afford a great security against luxation, it must be recollected, that in the moment of the accident, those which assist in retaining the head of the bone in the socket are placed in a peculiar situation. As the force is suddenly applied, they are taken as it were by surprise, and are unprepared to resist. Hence the head of the bone is more readily dis-

placed, than if these muscles were in strong action. From the securities afforded by the bones and ligaments, the hinge joints are more difficult to luxate than the orbicular joints. Hence the luxation of the former is always attended with greater danger than that of the latter, although the displacement is never so complete, because a greater force is required to produce the accident, and the laceration of the soft parts is generally more extensive. Still when luxation is not complicated with a wound, when there is little injury done to the soft parts, and when a surgeon has been called shortly after the accident, the dislocation cannot be viewed as a serious injury. But although the luxation may not be attended with any violent hurt of the soft parts, and although it may speedily be reduced, it sometimes happens that the head of the displaced bone has been so situated, as to press upon the principal nerves of the limb, and produce numbness and palsy; and these affections sometimes continue for an indefinite time after the pressure is removed. This state frequently happens when the head of the shoulder bone is lodged in the axilla, so as to compress the cord of nerves which goes to animate the muscles of the arm. I was once called to a female who had dislocated her shoulder by falling over a bed. The head of the bone was lodged in the axilla, and although it had only been displaced for twelve hours and was easily reduced, the brachial plexus hade ben so compressed, that notwithstanding the

continued use of frictions with a variety of liniments, the fingers remained curved and powerless at the end of twelve months after the accident. Whether she ever entirely recovered the use of her hand I do not know, as I had not an opportunity of seeing her, or hearing from her, after that time. From the pressure of the head of the bone upon the veins and lymphatics, the lower part of the limb is frequently swelled, and the pulse sometimes beats languidly, or is suppressed by the compression of the principal artery.

When a joint has been long dislocated, the head of the displaced bone acquires new connections, and an artificial socket is formed with which it contracts adhesions. If the head of the bone rests among the muscles, the new socket is formed by the thickening and adhesion of the surrounding cellular substance, and in this case, the articular cartilage covering the head of the bone remains without undergoing any alteration. If it is in contact with a bone, the periosteum is rubbed off in consequence of the friction; by the increased action of the vessels granulations are formed; ossific matter is at last deposited; and thus a bony socket is formed. In both these circumstances, the original articular cavity fills up partly by ligamentous, and partly by ossific matter, the muscles become permanently contracted, and when this change has taken place, it becomes difficult or impossible to dislodge the head of the luxated bone, and it is not always safe to attempt

it. In luxation of the shoulder or hip, the motion of the joint is lost; but after a time, the new cavity is formed, and the limb then regains a certain degree of motion, although from want of its former action, it always becomes emaciated, and remains weak.

The head of the bone most commonly continues fixed in that situation in which it is placed by the accident; but sometimes the action of the muscles, subsequent to the dislocation, changes its position. This not unfrequently happens to the head of the shoulder bone, which, in consequence of the dislocation, is carried into the axilla; but after a short time, the muscles change its direction and retract it under the great pectoral muscle, where it lies upon the chest. This secondary effect of the muscles upon the displaced bone, was first observed by Desault and other French surgeons, who termed it a consecutive luxation, in contra-distinction to the luxation which was caused by the accident, and which they called a primitive luxation. These two divisions form a good distinction in practice.

The observations which we have now made apply entirely to luxations caused by external violence, but a bone may be wholly or partially displaced from its articular cavity by disease. In consequence, also, of a relaxed state of the ligaments and muscles, even the common action of the part will throw out the bone. When those muscles which are implanted near the head of a bone, and

one of the chief uses of which is to retain the bone in its place, become paralytic, the bone drops from its socket. A bone is also sometimes slowly displaced, by tumors forming within the cavity of the joint; or sometimes the socket is attacked with caries, and, after its destruction, the muscles retract and displace the bone, as happens in the advanced stages of the hip-disease. In all these cases the luxation is more unmanageable than when it occurs in consequence of external violence.

GENERAL TREATMENT OF SIMPLE LUXATIONS.

It is universally admitted, that every luxated joint should be reduced as speedily as possible; and this will be found more or less easy, according to the strength of the muscles, and the length of time the joint has been displaced.

It is impossible to say after what length of time a luxation becomes irreducible. In the orbicular joints, it is longer of arriving at this state than in the hinge joints; because in the latter, the luxation is generally the consequence of a greater degree of violence; and because the bone being seldom completely displaced, the inflammation which ensues soon stiffens and partially anchyloses the joint.

The two great causes which oppose the reduction of the bone, as we have just now observed,

are the resisting power of the muscles, and the length of time the bone has been displaced. The difficulty of reduction arising from the length of time a bone has been displaced, does not depend merely upon the adhesions which it may have formed with the neighbouring parts, but proceeds in a great measure, from the permanent contraction of the muscles. This contraction is not readily overcome,—hence they are with difficulty elongated, and the difficulty increases in proportion to the length of time the luxation remains unreduced. As the resisting power of the muscles, and the length of time a bone has been displaced, form the chief barriers to the reduction, it must therefore follow, that the longer a bone has been displaced, and the stronger and more muscular the patient, the more difficult will be the reduction. In childhood, in old men, and in females, when the luxation is recent, we generally succeed with very little force; whereas, in strong muscular men, it requires great power to overcome the resistance of the muscles.

It is now agreed, that the best way to reduce a luxation is by means of extension and counter extension; and in its application, there are a few fixed principles which guide our practice.

1*st*, The resisting power or the counter extension, should always be fully equal to the extending power, otherwise the resistance will not be sufficient to oppose the extension, and the bone, from

the cavity of which the luxation has taken place will yield and prevent the reduction.

2d, The counter extension should always be applied to that bone whence the luxated bone has been forced; while the extending power should be applied, if possible, to the farther extremity of the displaced bone*.

3d, All those muscles which can exert any influence in opposing the reduction, should be put in a state of relaxation. Thus, in reducing luxa-

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* In the reduction of luxation, all the ancients, Petit, Duverney, Mr Pott, and the English surgeons reduce by applying the extending force to the inferior part of the luxated bone; while Desault always applied the extending power to the lower part of the limb,—as to the wrist, in luxations of the shoulders, and to the ancle, in luxations of the hip, and this practice is now universal amongst the French surgeons. They assign as their reason, that by so doing, they act with a longer lever, by which, the reduction is rendered easier; and they affirm that they are less liable to excite a spasmodic action in the muscles immediately connected with the joint, as in the biceps, when the head of the shoulder bone is thrown downwards into the axilla. But by adopting this practice, we are in great danger of injuring the elbow or wrist joint, or both; besides, by extending the forearm, we put the long head of the biceps on the stretch, which will not only produce great pain, but also impede the reduction. The reduction of the shoulder should therefore, I conceive, always be attempted with the forearm bent; the extending power should be applied to the lower end of the humerus, and we can easily extend the lever by lengthening the cords.

tion of the shoulder and hip-joints, we place the elbow and knee joints in a state of flexion.

4th, The extending power should not be applied in jerks, nor violently, but conducted slowly and steadily. Compound pulleys are therefore preferable to cords pulled by many assistants; because the extension requires only one person to effect it, and can be more uniformly and gradually applied; it is at the same time more powerful, and any intelligent person can easily calculate the force which he employs.

5th, The extension should be applied in that direction, which will most effectually raise the head of the displaced bone from the unnatural situation in which it is lodged; but when this is accomplished, the extension should be continued in the natural direction of the bone, inclining it so as to keep its head from catching on the edge of the socket or any bony process.

And *6th*, In the reduction of luxation of the larger joints the extension and counter extension should always be committed to assistants, while the surgeon should place himself at the dislocated joint, to ascertain the progress that is made in the dislodgement of the head of the bone from its unnatural situation, and otherwise to direct the measures necessary to effect its reduction.

These few general principles, besides regulating the whole of our conduct in the management of luxation, point out the danger and impropriety

of employing the ambé of Hippocrates, the table napkin recommended by Heister, the door and ladder, and other machinery delineated in Oribasius, Parè, Scultetus, &c.

All these instruments, which have been particularly employed in luxation of the shoulder, while they extend the bone, force its head against the edge of the glenoid cavity, endangering its being fractured, as well as rupturing the vessels, and being apt to break the humerus. On one occasion when the ambé was used, the artery was torn, and the surgeons were compelled to amputate immediately.

In powerful men, where it is difficult to overcome the contraction of the muscles, it has been recommended to induce weakness by intoxication, bloodletting, the warm bath, and by exciting nausea by means of small and repeated doses of tartarite of antimony. This plan may be adopted, but, I believe the preferable practice is by slow and repeated extension to exhaust their strength. Where the patient is strong, and the luxation not recent, gradual extension should be applied, and continued at intervals for half an hour, repeating it evening and morning for several days in succession,—not with a view to effect the reduction, but to destroy adhesions, and to elongate and fatigue the muscles. After this practice has been persisted in for a few days, it is wonderful with what ease the bone is sometimes replaced. In this way I have been able to reduce luxations of

the shoulder, of three months duration, without much difficulty. When luxation occurs in the round joints, even although not very recent, the reduction should always be attempted with care, particularly in females, and in old and debilitated subjects.

When the extension has been so successfully applied, as to bring the head of the displaced bone on a level with its articular cavity, and is dropped suddenly, the head of the bone being at the same time directed towards the socket, the muscles will draw it into its place with a sudden noise or jerk. We shall be assured of the reduction by the diminution of the pain, by the freedom of motion, by the natural appearance of the joint, by the limb being of the same length with the sound one, and by manual examination. Although the joint after reduction resumes its natural form, it always appears larger, because from the laceration of the capsular and other ligaments, the bones are never so completely braced down and held together as before their rupture. This enlargement is always most conspicuous in the hinge joints; and I have observed it in a more marked degree in the elbow, than in any of the other articulations.

Although it be desirable to reduce every luxated joint as speedily as possible, no attempt should be made to effect it when the joint is swelled and inflamed, our practice here coinciding entirely with that respecting fractures; and there

may exist in luxation as in fracture, two states of swelling,—one, which immediately follows the injury, and arises from blood effused into the cellular substance, in consequence of ruptured veins, —and another which follows at some distance of time, from increased vascular action. In the former there is neither heat nor redness, and, comparatively speaking, the pain is little; in the latter there are tension, heat, redness, and great pain, especially when moved. The first state does not preclude us from immediately attempting to replace the luxated bone. In the second state of the limb, no attempt should be made at reduction, till the inflammation, pain and swelling are subdued, which is to be effected by local bloodletting, saturnine lotions, warm saturnine and opiate fomentations, conjoined with rest.

After the reduction is effected, the joint should not be moved for some time. The limb should be kept at rest and secured by a bandage, otherwise it is very apt to be again displaced and for ever after remain a weak joint, liable to be luxated upon the slightest accident. This often happens with the shoulder joint when it has been too early moved. The capsular and lateral ligaments are lacerated, in all luxations arising from external injury, and not unfrequently the muscles are torn from their insertions; the former therefore require time to heal, and the latter must be kept at rest till they regain their attachments.

COMPOUND LUXATIONS.

When the head of a bone is not only dislodged from its articular cavity, but forced through the integuments or complicated with a communicating wound of the soft parts, the injury is denominated a compound luxation.

Compound luxation is always a serious accident. It is more dangerous than compound fracture, in as much as the laceration and exposure of a joint are more apt to be followed by high inflammation, and greater consequent constitutional derangement, than a wound produced by the fractured extremities of a bone, provided in this case no large blood-vessel is wounded. The danger depends upon the injury done to the soft parts, the extent of the laceration and contusion, the length of time the joint has been exposed to the air, the constitution of the patient, and many other circumstances. Compound luxation may occur in any joint where the violence has been so great as to lacerate the capsule and other ligaments, and force the head of the displaced bone through the integuments; but it most commonly happens in the ancle joint, and in nine cases out of ten is complicated with fracture of one or both of the bones of the leg.

TREATMENT OF COMPOUND LUXATIONS.

In the treatment of compound luxation, as in that of compound fracture, no specific rule can be laid down. The management of the case must depend upon existing circumstances, which must be left to the judgment of the surgeon. In compound luxation of the ancle joint, there is generally a complication of fracture; and this combination of luxation, fracture and laceration of the soft parts, with exposure of the joint, has been viewed in so serious a light, that Petit, and Pott inculcated the necessity of immediate amputation. This practice was long universally adhered to in France and England; but, within the last twenty years, the management of compound luxation has in both undergone an important change, and amputation is now rarely resorted to. In the great majority of cases an attempt should be made to save the limb. The cases of Mr. Hey of Leeds, and Mr. Astley Cooper, and the experience of every practical surgeon justify this step. Where the soft parts are much contused, where the laceration is extensive, and where the joint has been long exposed to the air, it may, no doubt, be necessary to amputate; but otherwise we should reduce the luxation, and attempt to save the limb. Indeed, in every instance, our first object should be to reduce the bone. We ought then, and not before, to determine the treatment. The bone can

sometimes be replaced through the wound at which it protruded, by putting the limb in such a situation as to relax the opening; when this cannot be easily done, no rude attempt should be made to effect it; but the opening should either be enlarged, or the projecting portion of bone sawn off. The enlargement of the wound is decidedly preferable to the removal of the protruding bone for two very obvious reasons,—First, where the bone is sawn off, the limb must be shortened,—Secondly, if this portion of bone forms a part of the joint, its removal will produce complete or partial anchylosis. When the bone is reduced, the edges of the wound should be brought together, and retained so by adhesive plaster, every attempt being made to unite it by the first intention. On many occasions the inflammation is slight, the wound adheres, and the cure proceeds without one bad symptom. On other occasions, considerable inflammation and swelling succeed, which excite great constitutional irritation, and are apt to terminate in gangrene. When the inflammation seems disposed to rise high, any splints or bandages with which the limb may be secured, should be removed, and leeches and saturnine lotions immediately had recourse to. In some cases it may be proper to abstract blood from the general system, and in all circumstances, strict antiphlogistic remedies and diet should be employed. If the inflammation still increase, poultices and warm fomentations should be used, which, by in-

ducing suppuration, lessen both the local and constitutional action, and save the limb from falling into gangrene.

It is necessary to observe, that where the surgeon has been long of being called, and the parts are much inflamed and swelled, no attempt should be made at reduction by enlarging the wound or otherwise, till the inflammation and swelling are subdued by leeches, poultices, and warm fomentations.

PARTICULAR LUXATIONS.

LUXATION OF THE LOWER JAW.

The condyles of the lower jaw are received into two cavities in the temporal bone, and these are so protected by bony ridges, posteriorly and laterally, that no luxation can possibly take place in these directions. Like other articular sockets, they are lined with cartilage which covers the root of the zygomatic process, and forms a part of the joint, so that when the mouth is opened wide, the condyle mounts upon the root of this process, and is then so situated, that any force applied to open the mouth wider, would make the condyle start forwards, luxate the jaw, and place it before and under the process. This joint is so much used, that its motion is required to be extremely free; and this is effected by the condyles

being covered with moveable cartilages which follow them in their several movements. From this extent of motion, and the capsule being so loose and weak, luxation would frequently take place, were it not prevented by the strength and action of the muscles of the jaw.

From the nature of its mechanism, it is evident that the joint of the lower jaw can only be luxated forwards. This accident occurs from the mouth being too widely opened, as in excessive yawning, or from the chin being suddenly forced down when the mouth is so opened as to bring the condyles forward, and place them upon the root of the zygomatic process. Both condyles may be luxated at the same time, or the accident may occur on one side only, causing a partial dislocation. When the luxation is on both sides, the nature of the injury is easily discovered. The mouth is wide open, the patient can neither shut it nor speak, the saliva flows from the mouth, and he swallows with difficulty. If the fingers are pushed up behind the condyles, a vacancy can be felt on each side immediately before the ear; and if they are applied to the cheek, the coronoid process will be distinctly perceived prominent under the os malæ. This luxation is always attended with great pain. In partial luxation, or when one condyle only is displaced, the chin is generally thrown to the opposite side; but this is not always the case, and the accident may be easily discovered by the hollow behind the condyle, and

by the prominence of the coronoid process in the cheek.

The jaw is in general easily reduced, and in effecting the reduction, the patient must be placed on a low seat, with his head reclining on the breast of an assistant, and in that situation kept steady. The surgeon covers his thumbs with a piece of linen, or puts on a pair of thick leather gloves, to protect them from injury; and he then carries them along the teeth of the lower jaw as far back as he can,—while, with his fingers and the palms of his hands, he embraces all the external surface of the jaw, from the angle to the chin. He should now with his thumbs push the jaw downwards and backwards, while he brings the chin upwards with his hands, when the muscles will in general pull the condyles into their place. This they do so suddenly, that the surgeon must be prepared to slip his thumbs betwixt the teeth and the cheek, otherwise they would suffer from being caught between the jaws. If, after two or three trials, he fails to reduce the luxation, he should attempt first to replace one condyle, by making the pressure on one side, and then proceed in like manner with the other condyle. This practice is sometimes found to succeed, when attempts to reduce both condyles at once have failed. After the reduction, the mouth must be kept shut; the patient fed upon liquid nourishment; and the jaw secured till the capsule heals, which is effected by means of the four-tailed roller re-

commended for fractures, described and represented in pages 490, and 491, of vol. 1st.

LUXATION OF THE CLAVICLE.

THE clavicle connects the upper extremity to the trunk, and has two articulating heads,—one which is received into a cavity at the top of the sternum, and the other which is attached to the acromion process of the scapula. That which is connected with the sternum is extremely free in its motions, while that which is attached to the scapula is very limited. The sternal extremity moves with every motion of the arm, and, like every joint where the motions are constant and free, is provided with an interarticular cartilage to guard against accidents. For the same reason it is farther secured by a strong capsule, which receives additional strength from the tendinous expansion of the mastoid muscle. The scapular extremity of the clavicle has a very obscure motion, both from the nature of the joint, and from being restrained by the trapezoid and conoid ligaments, which connect the clavicle and scapula.

The clavicle is, from its exposed situation, more frequently fractured than luxated, although luxations do occasionally present themselves, and may take place at either of its joints. When the accident does occur, it happens more frequently to the sternal extremity than the acromial, from the

freedom of motion which that joint possesses. When the shoulder is forced forcibly backwards, the sternal end of the bone is pressed so far forwards, that it not unfrequently bursts the capsule and is luxated. In this luxation, the end of the bone is felt like a knob under the skin. It can be made to roll by moving the arm, and the articular cavity in the sternum is found empty. The luxation is easily reduced, but difficult to retain, as the capsule and ligamentous connections being torn, the head of the bone slips from its cavity, upon the slightest motion of the shoulder.

In the treatment of this luxation, we lay hold of the arm, raise the shoulder, pull it back to lengthen the space betwixt the acromion and sternum, and with the thumb force the end of the clavicle into its place. We then apply a firm compress upon the seat of the injury, and keep the shoulders back as in fracture, by a roller passed in the form of the figure of 8, or by means of the bandage we have recommended for fractured clavicle; this is to be preferred, as we can more easily from time to time brace the shoulders back. We at the same time moderately raise and support the forearm in a sling.

It is worthy of remark, that in this luxation, notwithstanding every care, there always remains an unseemly lump after the cure is effected.

The clavicle is so firmly joined to the acromion, that luxation at this joint is extremely rare. The injury may be produced by falls or blows on the

top of the shoulder; and they effect it by carrying the scapula downwards, while the clavicle starts upwards. The securities of this joint are very great. Thus it is in a great measure protected by the acromion; both this process and the clavicle are struck at once; and the scapula, from the manner in which it is connected with the chest, glides upon its cushion of muscles, and eludes the blow. When the accident does occur, it is attended with a rupture not only of the capsule, but also of the trapezoid and conoid ligaments. It has been mistaken for luxation of the shoulder joint, but by a little examination its nature is easily discovered. By running the fingers along the clavicle, the end of the bone can be felt projecting under the skin; there is a hollow beneath it; the shoulder falls downwards and forwards; the head inclines towards the injured side; and there is an inability to raise the arm to any height. It is distinguished from luxation of the shoulder by the glenoid cavity being found occupied by the head of the shoulder bone, and by feeling it roll upon moving the arm.

In the treatment of this luxation we raise the shoulder, brace it backwards, place a compress upon the end of the clavicle, press it down, apply the bandage recommended for fracture, and support the fore arm in a sling. These means of security must be kept long applied, because from the rupture of the connecting ligaments of the

clavicle and scapula, it is long before the parts regain their attachments.

LUXATION OF THE SHOULDER JOINT.

THE shoulder joint is the least complicated joint in the body, and has the least securities from ligaments or points of bone. From its structure it is the freest in its motions, and is withal the most used; it is therefore more liable to luxation than any other joint. Luxation would more frequently occur in it, were the joint not greatly protected by the manner in which the scapula is connected with the trunk. It is laid upon a cushion of muscles, and although the joint is not strong to resist a great force, yet the scapula slips and eludes the injury. The glenoid cavity of the scapula is so superficial, that it can afford no security against displacement, and the head of the os humeri may be said rather to be laid upon, than received into it. The capsule arises from the circular edge of the socket, surrounds the head of the shoulder bone, and is implanted into a rough line immediately behind the head of this bone. It is also thicker at its upper part, in consequence of the attachments of the tendons of muscles, and of an additional ligament which comes from the point of the acromion process and is spread over it; but it is not strengthened at the sides by accessory or ateral ligaments, like the hinge joints. It is of

the same length in the whole of the circle, does not possess much strength, and is evidently intended rather to contain the sinovia, than to secure the joint; although it must no doubt afford a security, at least to a certain extent.

The chief strength of this joint does not reside in its capsule, but is derived from the four muscles which are implanted into the tuberosities of the shoulder bone, and which not only retain the head of the bone in the socket, but, from the adhesion of their tendons, strengthen the capsule as they pass over it. When we consider the structure of the shoulder joint, that its capsule is of an equal length all round, and is implanted immediately behind the head of the bone, and that the head is large, has no neck, and forms a small segment of a large circle,—when we consider moreover, that in luxation of this joint, the force is suddenly applied, and the head of the bone is frequently carried two or three inches from its natural situation; we shall have no difficulty in perceiving that the capsule must always be largely lacerated, and that in many cases, it must be even torn nearly in its whole circle. If any of it remains entire it must be the upper part, because it is in a peculiar manner strengthened by those muscles which are implanted into the tuberosities of the bone, and because the luxating force is not directed against that point so as to produce laceration. From the connection which the muscles inserted into the tuberosities have with the cap-

sule, and from their being implanted immediately behind the head of the bone, it will be evident also, that when the head is carried to any distance from its natural place, one or more of these muscles must be torn, according to the direction in which the bone is luxated. In one case to which I was called, where the head of the bone was lodged under the pectoral muscle, it would not remain in the socket, after the reduction was effected from the lacerated state of these muscles, but fell down leaving the upper half of the glenoid cavity unoccupied, in the same manner as it does in the dead body, or when the muscles are paralized. It was necessary therefore, to have recourse to stays to keep up the bone till the muscles regained their attachments, which they soon did.

That the capsule is always largely lacerated and the muscles are frequently torn, is not only evident from the structure of the joint, but is also proved by dissection*; it is therefore far from correct to imagine, that there is merely a slit in the capsule, which permits the head of the bone to escape.

When we look to the mechanism of the shoulder joint, and consider the various directions in which the head of the bone may be luxated, we shall find that the conclusions which we deduce a prio-

* See Bonn, de Humero Luxato, and Thomson's paper in the Medical Observations and Enquiries. There are also other cases on record where the capsule was torn to pieces, and where the muscles were separated from the shoulder bone.

ri from its mechanism, accord very exactly with the results of practice.

1*st*, The joint is open and undefended in the whole of its circle, except at the upper part where the acromion process so overhangs it, that no luxation can possibly take place in that direction without a fracture. There is an additional security against it derived from the ligamentum triangulare proprius scapulæ, which passes directly across from the acromion to the coracoid process of the scapula; besides this, the deltoid and the supraspinatus muscles, with the long head of the biceps, present a resistance ~~with~~ no impelling which power that can be applied in that direction is sufficient to overcome; and accordingly we never meet with luxation upwards.

2*nd*, The under part of the capsule is the weakest, and is not strengthened by any muscle, nor the glenoid cavity protected by any point of bone. Moreover, from the general motions of the arm any, force must be more frequently directed against this point than any other part of the joint, and hence luxation downwards must be a very common occurrence. In fact, both the form of the joint and the direction in which the luxating force is most commonly applied, determine luxation of the shoulder joint to be in 99 cases out of 100 down into the axilla. This luxation is therefore always primitive, and is produced either by the extended arm being suddenly raised till it is stopped by the acromion process of the

scapula, or by the head of the bone being forcibly pulled or projected against the lower part of the capsule by the action of the muscles. In the first of these cases, the accident most commonly happens in putting forth the hand to save oneself in a fall. The whole weight is then thrown on the extended arm, which acting with a long lever, stretches the lower part of the capsule, bursts it up, and turns the head of the bone down into the axilla. When the bone is displaced by the muscles, the luxation may arise either from their pulling the head of the bone downwards when the lower end is fixed, or by their suddenly pulling the lower end of the bone upwards, while the head is kept down by muscles acting in an opposite direction. Thus, if the arm happens to be raised from the side, a fall upon the inner part of the elbow will produce this luxation. The elbow is at this time fixed upon the ground, and the head of the bone being pulled suddenly downwards by the pectoralis major latissimus dorsi and teres major, the lower part of the capsule is lacerated, and the head is lodged in the axilla; or, if the arm is thrown suddenly upwards, while these muscles fix the head of the bone, the action of the deltoid muscle impels it against the lower part of the capsule which is thereby torn, and the bone then escapes into the axilla. This manner of luxation is exemplified in the case mentioned by Bichat, of the notary, who luxated his arm by lifting a register; and also, I apprehend, by the

following case which occurred sometime ago in my own practice. A coachmaker, after his men had left off work in the evening, attempted with little assistance to raise a carriage, in order that he might get slipped under it, a machine called the setters, by which the carriage is supported when the wheel is taken off. He applied his shoulder to the carriage and made a sudden effort to raise it, when the head of the bone was immediately displaced; he suffered great pain during the night, but did not apply for assistance till next morning, when I found the head of the bone in the axilla. Being a strong muscular man, powerful extension was required to effect its reduction. The luxation, in this case, must have been produced by the action of the muscles, as he received no blow upon the top of the shoulder,—the carriage did not fall down upon it,—there was not the slightest discoloration of the integuments,—and the accident was produced during the sudden exertion of throwing up the arm.

When the head of the bone has passed into the axilla, it is situated betwixt the long head of the triceps and the tendon of the subscapularis muscle; and it may either remain fixed in that situation, or it may be carried farther back,—as by the action of the muscles, in consequence of a second fall, or of some awkward attempts at reduction, forming a consecutive luxation. It can never be drawn backwards so as to be placed on the posterior surface of the scapula, the long head

of the triceps effectually preventing it being carried in that direction; and it therefore always passes on the anterior surface of that bone, under the tendon of the subscapularis muscle, into what has been called the fossa subscapularis. The bone is sometimes retracted so far upwards as to be placed at the root of the coracoid process, and in some occasions even behind the clavicle. To permit the head of the bone to be thus far removed from the glenoid cavity, it is evident not only that there must exist an extensive laceration of the capsule, but that those muscles which are inserted into the greater tuberosity of the humerus must be torn, more especially the supraspinatus.

3d, If the arm should by any accident be carried forcibly backwards, so that the head of the humerus is powerfully impelled against the anterior part of the capsule, this will be lacerated, and the head of the bone will escape from its cavity, so as to form a luxation forwards. As this part of the capsule is covered by the fibres and tendon of the subscapularis, the head of the bone will be lodged, as in consecutive luxation, in the fossa subscapularis, at the root of the coracoid process; and in that case it can be felt covered by the pectoralis major and minor, and subscapularis muscles. But if the force by which the luxation has been produced is great, the fibres of the subscapularis may be so lacerated as to permit the head of the bone to pass farther forward, and get above that muscle so as to be placed betwixt

it and the serratus magnus, and pectoralis major. I conceive that in consecutive luxation, the head of the bone is always situated betwixt the scapula and subscapularis muscle; but that in primitive luxation forwards, it may sometimes be placed under, and sometimes above the muscle, according to the force which has been applied to effect the luxation.

4th, While the arm is advanced towards the chest, if the head of the humerus be forcibly projected against the posterior part of the capsule, this may be ruptured; the head of the bone will then escape, and be placed upon the posterior part of the scapula under the spine, in the fossa infraspinatus. In this situation it is covered by the infraspinatus, teres minor, and deltoid muscles. This species of luxation must be extremely rare, from the bone being seldom placed in such a position that it can act upon the posterior part of the capsule; but that it may occur, we have the authority of Galen, Paré, Bonn, and Fizeau, all of whom have seen it. It has also presented itself in the practice of some of the surgeons of the present day.

From the foregoing considerations it appears, that the shoulder bone can never be luxated upwards, but that it may be luxated downwards, forwards, and backwards. When luxated downwards into the axilla, the luxation must always be primitive. When luxated forwards, the luxation may be either primitive or consecutive. When

the dislocation is backwards, it is always primitive. It is to be regretted that in luxation forwards, the primitive cannot be distinguished from the consecutive except by the history of the case; but this should be minutely attended to, as being of essential importance in practice. If the luxation is consecutive, it will be much more difficult to reduce than when primitive, as the head of the bone must retrace the same course by which it has been placed in its unnatural position, and be first brought down into the axilla before it can be replaced in the glenoid cavity; whereas, in primitive luxation, the reduction is more easily effected, because the bone may be replaced by a shorter and more direct route.

Luxation of the shoulder is easily detected, when there is little swelling or contusion of the soft parts; but even when these exist in a considerable degree, the symptoms are sufficiently characteristic of the injury. The situation of the head of the bone, and the position of the limb, will be determined by the nature of the luxation; but in whatever direction luxated, there is always great pain, with evident distortion, and the shoulder loses its roundness. If the surgeon runs his fingers along the spine of the scapula till he comes to the point of the acromion process, he will be able to pass them deep under the process, and will feel the glenoid cavity empty. This can always be easily done in spare people, but even if the patient should be fat or very muscular, he

will always be able by raising the arm to a right angle with the body, and then relaxing the deltoid muscle, to discover the state of the socket. When luxated, the joint feels locked, the motions of the arm are considerably circumscribed, and the patient cannot carry his hand to his head in a semicircular direction. The head of the bone will in general be found deep in the axilla, or lying upon the breast, as these are the most common kinds of luxation, and it can be made to roll in either of these situations. In such luxations, the forearm is generally bent, from the twisting and distortion of the biceps muscle, and the patient inclines to the injured side. When the head is lodged in the axilla, there is an angle at the insertion of the deltoid, as if the bone were broken; the artery beats languidly; and the whole arm is thrilled and benumbed by the pressure of the displaced bone upon the artery and nerves. Sometimes from this pressure the arm is quite palsied, from which circumstance, it takes long to recover, and in some instances where the pressure has been long continued, the limb has never been completely restored.

In the reduction of the shoulder bone, we apply all those principles which we have already laid down for the general treatment of luxations. In conducting the operation, the patient should be in such a position that his arm may be raised so as to form an obtuse angle with his body; while we at the same time press down the

acromial end of the scapula so as to place it obliquely. When both bones are in this situation, the muscular fibres of the supraspinatus, or any remaining part of the capsule attached to the upper part of the bone, and which may be spread over the glenoid cavity, will be so relaxed as to permit the head of the displaced bone to glide more readily from under the neck of the scapula, and make it less apt to catch on the brim of the glenoid cavity.* The patient should be seated on a low chair or on the floor, and a pad or bolster is then to be put into the axilla so large as to fill up the hollow and rise above the edges of the pectoralis major, latissimus dorsi, and teres major muscles. This will prevent these muscles from being pressed upwards and acting in that direction upon the bone. Over this pad a broad belt or folded sheet is to be laid, and carried across the breast and back. It is to be crossed upon the top of the sound shoulder, and then fastened to a pillar, a ring in the wall, or any thing which is sufficiently strong to resist; and thus we keep back the trunk and scapula. The belt belonging to the apparatus of Mr John Hunter is now to be applied to the lower part of the humerus immediately above the condyles, and one of the pullies hooked to it, the other being at the same time at-

* See Mr Charles Bell's Operative Surgery, Vol. 2nd. where this impediment of the lacerated capsule to the reduction is well explained.

tached to some fixed point. An assistant now presses down the acromion of the scapula, while the surgeon bends the forearm and raises the arm so as to form an obtuse angle with the body. When matters are thus arranged, as is represented in plate sixth, the extension is to be begun, and to be continued, not in jerks, but gradually and steadily, till the head of the os humeri is brought on a level with the glenoid cavity.

The surgeon during this time is to support the arm with one hand, while with the other he feels for the head of the bone, and tries to guide it into its place. When the head of the bone is brought on a level with the glenoid cavity, if the extension be suddenly dropt, the action of the muscles will in general draw it into its place. Should this not be the case, the extension must be renewed; and when the head of the bone is again brought on a level with the socket, the surgeon should carry the arm downwards and forwards towards the side, using it as a lever to push the head into its place. At the moment that he does this, the extension is not only to be discontinued, but even a little relaxed. The extension should always be begun in the same direction in which the bone is thrown, and is to be continued till the head is disengaged from its new connections. The surgeon will feel it start from its place, when he should incline the arm forwards or backwards according to the nature of the luxation, and this he does the more effectually to remove any

impediment to its reduction. When the pullies which I have recommended are not at hand, or cannot be procured, the extension must be effected by sheets, table cloths, or hand towels, and to prevent the skin from being fretted, a roller should be passed along the arm before they are applied. The bone returns to its place with a jerk, which is distinctly heard,—the violent pain immediately ceases,—the patient can move the arm,—and the surgeon, by running his fingers along the spine of the scapula till he comes to the point of the acromion, and forcing them under the process, can feel the head of the bone in the glenoid cavity.

After the reduction has been effected, the arm should always be put in a sling and bound down to the side by passing a roller round the body. This allows the capsule to heal, and the torn insertions of the muscles to regain their attachments; it also prevents the recurrence of the accident upon slight exertions, for when once the shoulder bone has been dislocated and used before the soft parts have had time to heal, the joint is ever after easily luxated. Every one accustomed to dissection knows that the head of the shoulder bone is retained in its socket, not by its capsule which is loose and flaccid, but by the contraction and power of the muscles. Hence, in the dead body, the arm in a manner falls away from the scapula; hence we explain luxations from an internal cause or relaxation of the mus-

cles; and hence, perhaps, the frequent recurrence of this luxation arises from the muscles, which had been torn by the first accident, never having completely regained their attachments.

LUXATION OF THE ELBOW JOINT.

The elbow joint is composed of three bones, the os humeri, the ulna, and the radius; but the two former have the chief share in forming the joint. On the anterior and posterior surfaces of the os humeri, there are two fossæ deep enough to receive the point of the thumb,—the anterior one being for the reception of the coronoid process, and the posterior for the reception of the olecranon. Betwixt these two processes of the ulna is the sigmoid cavity, which embraces the shoulder bone so closely as not to permit the slightest degree of lateral motion. From the deepness of this cavity, and from the manner in which it contains the os humeri, the elbow joint constitutes a pure and simple hinge. When the arm is bent, but about to be extended, the extensor muscle implanted into the olecranon, performs that action with great power; and when the arm is extended, the process checks into the posterior cavity, and catches upon the end of the shoulder bone, so as to afford great security to the joint. In pulling, and in all other violent actions, this prevents the possibility of luxation forwards

without a fracture. When the arm is extended, but about to be bent, the coronoid process serves the same uses to the flexor muscle which the olecranon did to the extensor. As the olecranon guards the joint behind, the coronoid process, in like manner, protects it before; although it does not afford the same security against luxation as the olecranon, because the process is shorter and is not received into so deep a hollow. When the arm is extended as in pulling, the olecranon checks into its cavity and prevents luxation forwards; and when the arm is bent as in striking, pushing, and saving one's self from a fall, the coronoid process catches into its fossa and prevents luxation backwards. Upon the outer side of the greater sigmoid cavity of the ulna, there is a small hollow called the smaller sigmoid cavity, which receives the round head of the radius, permitting it to roll in circles round the ulna, as in the rotatory motions of the hand. The hollow or flat part of this head is turned towards the smooth little head of the humerus. Although the head of the radius is received into the capsule of the joint, moves along with the ulna, and is displaced with it in luxation, still it does not enter into the construction of the elbow joint, which, strictly speaking, is formed entirely by the humerus and ulna.

The elbow joint is strong with regard both to its bones and ligaments, and, although it is much exposed to accidents, it requires great force to luxate it. The capsular ligament arises from the

os humeri, and includes the lower head of the bone and upper heads of the ulna and radius, extending quite to the extremity of the olecranon, and comprehending the two fossæ on the fore and back part of the joint. Like every other hinge joint, it is stronger at its sides, and has lateral ligaments coming down from both the condyles of the os humeri, which are expanded upon its sides. There is also a peculiar circular ligament which embraces the neck of the radius, and which retains its head so securely in its cavity, that although it is displaced with the ulna in luxation, it still preserves its connection with that bone, so as not to be separated from it unless considerable violence has been inflicted. Independently of its ligaments, this joint is farther secured by several powerful muscles implanted close upon it.

In consequence of its construction the elbow joint cannot be luxated forwards, without a fracture of the olecranon, and this seldom happens. It may be luxated laterally, and, in this case, from the extent of articulating surface, the luxation is never complete. When luxated backwards, which is more frequently the case, the accident most commonly happens from a fall upon the palm of the hand. This most usually occurs in children while running at play, and arises from the general weakness of their joints, and from the coronoid process being shorter in them than in the adult. In this direction, the bones cannot be partially displaced, and therefore the coronoid process is

always driven completely back behind the lower part of the os humeri, and the capsular ligament is extensively torn. If the joint is left long unreduced, from the inflammation of the torn parts, adhesion soon follows, the reduction is then impossible, and the motions of the fore-arm are lost.

The signs of this luxation are so decisive, that it is hardly possible to mistake the nature of the accident. There is great pain with evident distortion, a shortening of the fore-arm, and a lengthening of the olecranon, which can be felt high up upon the back of the humerus; while the coronoid process is lodged in its fossa and occupies its place. The fore arm is a little bent, when we attempt completely to extend it, there is great pain and the joint is immoveable.

It is a common opinion that luxation of the elbow joint is very difficult to reduce. If this be the case, the difficulty is to be traced to the manner in which the reduction is commonly attempted to be effected. Thus we are generally directed to make an assistant lay hold of the arm above the elbow, in order to make the counter extension, while the surgeon is to extend the fore-arm by grasping at the wrist. Now, by following these directions, the reduction must be made extremely difficult, for the following reason. As the ulna, which is the bone luxated, has no connection with the wrist, while the radius enters into the composition of that joint, when we pull at the lower part of the ore-arm we have no hold of the small

lower end of the former bone, and any force we may employ, is communicated to it only through the medium of the interosseous membrane, which connects the bones of the fore-arm together, and thus must be in a great measure lost.

If the luxation is recent, the reduction may be effected in the following manner with the utmost ease. Let an assistant grasp the arm with both his hands, as if he were to pull against the surgeon; the surgeon then with his left hand lays hold of the fore-arm, while he at the same time places the palm of his right hand upon the projecting olecranon, as if he meant to thrust in a bolt. He now bends the fore-arm with the left hand, and at the same time pulls down the olecranon with the right, the assistant keeping the arm firm, when the bones will slip into their place with a loud snap, and with inconceivable quickness and ease. The bending of the fore-arm at the moment that the olecranon is pushed down, is the principal thing to be attended to in the reduction; and this method has succeeded when pulling the fore-arm with the utmost force has been tried in vain. When the luxation is not recent, but has remained so long unreduced that adhesions have formed, more force must be employed. In this case two additional assistants are required. While one of them grasps the arm, and holds it firm, a second lays both his hands upon the fore part of the humerus immediately above the bend of the arm, and pushes it strongly back; ano-

ther assistant at the same time seizing the fore-arm above the wrist makes as powerful an extension as he is able, while the surgeon bends the fore-arm and pushes down the olecranon. This manner of reduction frequently succeeds when the other fails as we here act with more power. As soon as the reduction is effected the fore-arm should be bent, put into a handerchief suspended round the neck, and kept in a state of rest for several days; but at the end of a week, the joint should be gently moved, and the motion increased daily to guard against anchylosis, which is very apt to occur in the hinge joints, when long motionless after the reduction of luxations.

When the bones are luxated forwards, and of course complicated with fracture of the olecranon, an instance of which I never saw, the reduction is effected by extending the fore-arm and employing a counter extension to the arm. When an extension has been made sufficient to free the bones, those of the fore-arm are to be pushed back, and when they are replaced, the injury must be treated as a fracture of the olecranon.

When luxated laterally, the luxation is never complete and is easily reduced. One assistant extends the fore-arm, while another grasps the arm and employs a counter extension. By this the bones being somewhat separated, the surgeon should push the humerus and bones of the fore-arm in different directions, when they will easily slip into their place.

When the bones of the fore-arm are driven backwards in luxation of the elbow joint, it sometimes happens that the orbicular ligament is torn, and that the head of the radius starts from its cavity and is separated from the ulna. The radius is also sometimes luxated by itself, but this kind of luxation is so rare that many authors deny its occurrence. I have once seen it. From the structure and general weakness of the joint in early life, this accident is more apt to occur in children than in adults. It may take place in consequence of falls, but it most frequently happens by raising children by the wrist to lift them over a gutter or drag them up stairs,—by which means the fore-arm is extended, the hand turned prone, and the head of the radius wrenched out of its cavity. In this case, the head of the radius can be distinctly felt above the outer condyle of the os humeri like the point of the thumb; the tendon of the biceps is stretched which renders the muscle tense, and thus the fore-arm is generally kept half bent; the hand falls prone and cannot be turned supine; and every attempt to bring it so is attended with great pain. To permit the head of the radius to be thus far displaced, the body of the bone must be separated in some degree from the ulna, and the capsular ligament with the interosseous membrane must be torn.

To effect the reduction, an assistant must, with both hands, grasp the arm firmly above the elbow; the surgeon then with the point of the thumb of

one hand, pushes the end of the radius downwards and forwards into its place, while, with his other hand, he lays hold of the wrist and extends the fore arm, at the same time turning the hand outwards as if he were bringing it supine. It enters its cavity with a snap, the pain ceases, and the patient is able to roll the wrist. As the head of the bone is very apt to be displaced upon motion, especially if the hand is turned prone,—the fore-arm should be kept half bent, the hand supine, and, for farther security, a compress should be placed upon the outer part of the elbow, and a bandage applied*.

LUXATION OF THE WRIST.

The radius at its lower extremity swells out into a broad surface, having a cavity for the reception of the two first bones of the carpus; its outer edge terminates in a small process, which assists in preventing luxation outwards; and upon its inner edge is an articulating small cavity, which receives the little ball on the lower head

* See an excellent paper on luxation of the upper head of the radius, in the 37th volume of the Recueil Periodique de la Societê de medicine de Paris, by M. Martin le jeune, first surgeon of the hospital la Charité at Lyons, containing observations on the structure of the joint in the child, the signs of the luxation, with the proper methods of reduction, supported by cases.

of the ulna. This articulation does not enter into the wrist joint, but has a distinct capsule. The ulna does not reach so low as, strictly speaking, to form a part of the wrist joint; but, upon its extremity is placed a moveable cartilage, which comes in contact with the third bone of the carpus; and the outer edge of the bone terminates like that of the radius, in a process, which in some measure assists in preventing luxation inwards. The wrist joint, then, is formed by the three first bones of the carpus, received between the styloid processes of the radius and ulna,—the two first, the scaphoides and lunare, entering into the cavity of the radius,—and the third bone, the cuneiform, resting on the moveable cartilage of the ulna. The whole is surrounded by a capsular ligament, which is not only strengthened by lateral ligaments, but derives considerable security from the anterior and posterior annular ligaments, which bind down and transmit the flexor and extensor tendons.

From the manner in which the wrist joint is formed, it is strictly a hinge joint, permitting little lateral motion. The hand bends backwards and forwards by the three first bones of the carpus moving upon the bones of the fore-arm, and it turns round by moving with the radius upon the ulna, without discomposing the wrist. This it effects by the intervention of the moveable cartilage betwixt the ulna and os cuneiforme. Independently of the joint formed by the carpal bones

with the bones of the fore-arm, the bones are covered, at their junction with each other, with smooth articular cartilages, and each of the joints has a distinct capsule; but the whole are so firmly tied together by numerous ligaments, and covered by the general capsule, as to permit rather a degree of elasticity than motion, forming, as it were, but one bone.

The wrist joint is extremely free in its motions, permitting flexion and extension to a considerable extent; and, although frequently luxated, it is so powerfully secured by ligaments, that great force is required to produce that injury. It may be displaced backwards, forwards, and laterally. The former is the most common kind of luxation; that forwards is less frequent; and the last is so extremely rare, that it is hardly worth taking notice of. When the luxation is backwards, the accident most generally occurs from falling upon the back of the hand, by which it is so much bent inwards, that the sudden pressure tears up the posterior part of the capsule, permitting the escape of the ossa scaphoides and lunare from the scaphoid cavity of the radius. The bones are so thinly covered with soft parts, that the nature of the accident is at once detected. There is a tumor on the back of the wrist formed by the carpal bones; the extremities of the radius and ulna project on the fore part; the hand remains bent and immoveable; and the bones of the fore-arm

can be completely traced so as to ascertain that there is no fracture.

To effect the reduction, an assistant, in order to make the counter extension, grasps the fore-arm with both his hands, having previously bent the elbow to relax the muscles; while the surgeon extends the wrist by pulling by the metacarpus, at the same time pressing upon the luxated bones to force them into their place. Should this attempt fail, more force must be employed, and while one assistant makes the counter extension, another should extend by pulling by the metacarpus downwards and inwards in the direction in which it is thrown. The hand must, at the same time, be bent still more, to turn the luxated bones round the extremity of the radius; while the surgeon forces the projecting bones with the points of his thumbs, downwards and forwards. The reduction is in general, but not always, easily effected. I was once called to a gentleman who had met with an accident of this kind, and in whom the luxation was produced by his falling upon the back of the hand, when bent in. He was a strong muscular man, and as there was considerable retraction, notwithstanding the force exerted by three powerful assistants I found the greatest difficulty in forcing the bones into their place. It was only after repeated extension that I succeeded. The luxation, indeed, was as difficult to reduce as I have found in many cases of that of the shoulder joint.

When the luxation takes place forwards, it occurs in consequence of the hand being forcibly bent backwards. It most generally arises from falls upon the fingers and lower part of the palm. This luxation is never so complete as when it occurs backwards, for the following reasons: any force applied to the fingers and lower part of the palm in a fall, can never act so directly and powerfully on the anterior part of the capsule, as a similar force, applied to the back of the hand, when bent in, does on the posterior part of the capsule; and, moreover, the capsule anteriorly is much strengthened by the tendons of the flexor muscles, and by the annular ligament which confines them. When the accident does happen, the bones of the wrist form a tumor on the fore part; the bones of the fore arm project behind, and the hand is extended and immoveable.

The reduction is to be accomplished, as in the opposite luxation, by extension and counter extension, while the surgeon at the same time forces the bones into their place.

From the great injury done to the soft parts in luxation of the wrist, inflammation, considerable swelling, and stiffness are apt to ensue. To obviate which, several leeches should be applied after the reduction, and repeated if necessary. The wrist should be occasionally fomented with saturnine and opiate fomentations,—the fore-arm and hand should be placed in a large splint, and suspended round the neck,—and cloths wet with

saturnine solutions should be kept constantly applied.

When the carpal bones are luxated from each other, which is sometimes the case, the accident most frequently happens to the os magnum or central bone. Its round head starts from the concave surface formed for it by the scaphoid and lunar bones, and projects backwards. Although the os magnum is the bone most liable to luxation, any of the other carpal bones may be displaced by violence. From their wedge-like shape, and from the manner in which they are connected, the smaller end being always turned towards the fore part, the luxation must be invariably backwards.

The nature of the accident is denoted by the rising of the bone, which, from being thinly covered, is both easily seen and felt, and the swelling is much more remarkable when the hand is bent than when extended. It is in general easily reduced by the surgeon grasping the patient's hand, and while he gently extends and rolls the wrist, with his thumbs forcing the bones into their place. When reduced the hand should be kept extended for some time; a compress should be placed upon the back of the wrist, and a roller applied, the fore-arm and hand being kept suspended round the neck.

LUXATION OF THE METACARPAL BONES.

The second, third, fourth, and fifth metacarpal bones, which support the fingers, are so firmly connected with the carpal bones, and possess so little motion, that at their junction with them they are never luxated; but the first one, which is connected with the thumb, and which is implanted upon the trapezium, from its free motion upon that bone is sometimes forced off it. When this happens it is most commonly luxated backwards, the thumb then remains bent and cannot be extended, and there is a tumor formed by the head of the displaced bone.

To effect the reduction, an assistant extends the thumb, the surgeon grasps the wrist with one hand, to make the counter-extension, while with the thumb of the other hand he forces the bone into its place. It is in general easily reduced, but is so liable to be displaced upon the slightest motion, that a compress and roller should be applied and worn for some time as recommended for luxation of the carpal bones.

Although the upper extremities of the metacarpal bones are all immoveable, except that which supports the thumb, their round heads at the lower ends, where they are connected with the phalanges of the fingers, are very apt to be displaced from the cavities which receive them.

They may be luxated forwards, backwards or laterally; and when luxated to either side, one of the lateral ligaments is always torn. They are generally luxated forwards, and the accident is easily detected by manual examination. The head of the metacarpal bone forms a tumor in the palm, and the extremity of the first phalanx of the finger can be felt projecting at the knuckle. From the wedge-like shape of the head of the bone, when the lateral ligaments are entire the luxation is reduced with difficulty. This is particularly the case with the three first metacarpal bones; and, indeed, it has been remarked, that when the head of the metacarpal bone, where it joins the first phalanx of the thumb, is driven in towards the palm of the hand, the reduction is almost impossible. Mr Hey of Leeds relates a case, where he and another surgeon of considerable experience, failed to effect the reduction by extension and by pressure on the dislocated extremity of the bone.—He also informs us that he had seen Mr. Bromfield and the other surgeons of St. George's hospital, unable to effect the reduction in such a luxation; and that Mr. Bromfield even stated, that he had known a surgeon, in attempting to effect it by extension, pull away the thumb at the second joint. As a farther corroboration of the difficulty of this reduction, Mr. Hey informs us that a surgeon of a neighbouring county having, in two cases, failed to effect it, cut down upon the extremity of the bone, forced it

through the skin, sawed off the head, then reduced it,—and treated it as a compound fracture, —there succeeded but little inflammation, and the patients recovered the use of their thumbs. We naturally ask whence does this difficulty of reduction arise?—Mr Hey after examining the joint, ascribes it to the head of the metacarpal bone being formed like a wedge,—and consequently, when it is once driven through betwixt the lateral ligaments, it becomes so firmly locked that it cannot be retracted. Mr. C. Bell recommends the thumb to be bent at the dislocated joint, so as to carry the head of the first phalanx round the metacarpal bone, but he speaks from the anatomy of the parts, and not from experience. I can only do the same, having never witnessed this accident. If this attempt at reduction should prove ineffectual, we must cut one of the lateral ligaments so as to free the head of the bone, when it will be easily reduced.

LUXATION OF THE FINGERS.

The phalanges of the fingers may be luxated in various directions. When luxated laterally, the lateral, as well as the capsular ligament, is always torn. They are most frequently luxated anteriorly in consequence of falls upon the extended fingers. There is pain with inability to move the fingers but these joints are so thinly

covered that the nature of the injury is very well marked. The bone should be immediately reduced, which is always easily effected by a little extension. Two small splints should then be placed along the sides of the finger, and secured by a narrow strip of linen or cotton, and the hand placed in a sling till the ligaments heal.

LUXATION OF THE HIP JOINT.

The securities of the hip joint are very great. There is not only a deep socket into which the head of the thigh bone is received, besides a strong capsular ligament; but there is also a peculiar ligament arising from the inside of the socket, and implanted into the head of the bone, with strong muscles inserted close upon the joint. From this security of structure, it is evident that nothing but the greatest violence can luxate the hip.

The margin of the acetabulum is bordered with cartilage, which deepens the socket, and from this there arises a strong capsular ligament, which is so attached as to embrace the root of the neck of the thigh bone all round, and completely to receive it within the capsule. The capsule is of great strength in its whole circle, particularly at its upper and outer side, where a strong ligamentous band comes down from the anterior and inferior spinous process of the ilium, and is spread

over this part of the capsule, running down in a direction towards the root of the great trochanter. The capsule serves a double purpose. It contains the sinovia which lubricates the joint, and it is so strong as to be of great use in securing it, and keeping the bone in its place. But independently of the capsular ligament, the joint has a farther security from the triangular ligament. This is about an inch in length, ~~is~~ attached to the inside of the socket at its inner side, and is inserted nearly into the centre of the top of the thigh bone. Moreover, there are many powerful muscles which surround the joint, and are implanted into the trochanters.

There are only two great joints which are liable to frequent luxation, and the luxation of which it is difficult to reduce. These are the shoulder and hip, that of the latter presenting the greater difficulty, although more easily explained. There is a marked difference betwixt the two joints in one respect. In the shoulder joint the capsule is so weak and short, that in luxation it is always largely lacerated, sometimes nearly in its whole circle; and the muscles which strengthen it, being implanted into the tuberosities close upon the joint, are generally torn,—hence the joint in future remains weak and liable to luxation: whereas, in the hip joint, the capsule is strong, and of so great a length, that it is seldom lacerated to any greater extent than permits the head of the bone to pass out; and the muscles connected

with it are inserted into the trochanters so far from the head of the bone, that they are not torn in luxation.

Luxation of the hip joint is rare, particularly so when compared with that of the shoulder, and we shall find a reason for it in the structure of the two joints. In the shoulder, the articular cavity is quite superficial, the head of the humerus large, and rather laid upon the socket than received into it; the capsular ligament is weak, there are no protecting points of bone or any internal ligament, and the motion is extremely free: whereas, in the hip, the socket is deep, the round head of the os femoris is nearly wholly received into it, the capsule is thick and strong, the internal ligament retains the head of the bone in its place, and the socket is peculiarly deep at its upper edge—that point on which the body rests, and that part at which luxation does most frequently occur.

The same mechanism that makes a joint difficult to luxate, makes the luxation of it difficult to be reduced; and with regard to this joint, our chief difficulties are the re-action and opposition of the muscles, the high edges of the socket, and the great distance to which the head of the displaced bone is carried. In a strong man the muscles resist the extension most powerfully, more especially if the bone has been any length of time displaced; the head, whenever it escapes from the socket, which stands in the centre of an eminence, slides down by the side of it, and rests

in the hollow above or below the acetabulum; and hence it is extremely difficult to disentangle the head from the processes and hollows of the bone, and raise it to a level with the high brim of the socket. Great violence is required to luxate this joint;—and the force which it is necessary to employ to reduce it, is often greater than can be commanded even by the help of machinery, or, at least, than can at all times be safely employed.

The head of the thigh bone may be luxated in four different directions,—1*st*, Upwards and outwards upon the back of the ilium; 2*nd*, Downwards and inwards into the thyroid hole; 3*d*, Upwards and forwards upon the pubis, where it joins the ilium; and 4*th*, Backwards into the sacro-sciatic notch. The two first of these luxations, namely, when upwards and outwards, and downwards and inwards, are the most common cases, —that of upwards and forwards is less common,— and the luxation backwards is extremely rare*.

* All these luxations are primitive. Boyer and other French writers imagine that the luxation backwards into the sacro-sciatic notch is never primitive, but always consecutive upon the luxation upwards and backwards. The head of the thigh bone when lying upon the dorsum ilii, might, no doubt, be forcibly pulled or driven backwards into the sacro-sciatic notch, forming a consecutive luxation; but to admit of this, the capsular ligament must be extensively torn, and most probably several of the muscular connections, because, in the luxation upwards and backwards upon the dorsum ilii, the trochanter major is always brought forwards, and braced down by that part

1st, The thigh bone is most frequently luxated in an upward and outward direction. This luxation is commonly produced by falling or leaping from a height, and alighting upon one leg, the whole weight of the body being sustained upon it. The head of the thigh bone is forced out at the upper edge of the acetabulum, and lodged upon the back of the haunch bone. It passes under the glutæus minimus muscle, and is in immediate contact with the bone. The head of the bone is thrown backwards, the trochanter major is carried forwards, nearer the anterior superior spinous process of the ilium resting upon that bone, and the limb is thus distorted.

The signs of this luxation are as follows: the limb is shortened, the thigh is bent, the knee is carried forwards and inwards, the foot is turned inwards, the toes point in that direction upon the ground, there is dreadful pain, the limb is immoveable, at least it cannot be rolled outwards, extended or separated from the opposite thigh, and, when attempts are made to do so, the pain is excruciating.—In addition to the signs now enumerated, a tumor can be felt upon the haunch under the glutæi muscles, while there is a flatness in the seat of the trochanter.

The signs taken collectively are sufficiently

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of the capsule which remains entire; it is therefore probable that the luxation into the sacro-sciatic notch is generally primitive, and not consecutive.

characteristic of this luxation, although the position of the limb can be by no means viewed as an invariable and decisive mark. From the position of the head of the bone, all the muscles inserted into the greater and lesser trochanters, as well as the adductors of the thigh, must be in a state of relaxation, with the exception of the gemini, the two obturators, and the quadratus femoris, which are in a state of tension, and which, if the limb were left free to their operation, would invariably turn the toes out. It is the action of the muscles which gives the position to the lower part of the limb in all luxations, and were there no counteracting cause, the toes in this luxation would be undoubtedly turned outwards. We have already remarked that from its length and strength, the capsule of the hip joint is generally in luxation torn to no greater extent than just to permit the head of the bone to escape. This is particularly the case in the luxation upwards, as the upper and outer part of the capsule is strengthened by ligamentous fasciculi, which come down from the lower and anterior spinous process of the ilium. In the luxation upwards and backwards, therefore, the upper and outer part of the capsule, which remains entire, turns the trochanter major forwards and braces it down, by which means the head of the bone is thrown backwards, and is so mechanically fixed in that situation, that the muscles cannot exert their influence and roll the limb out, as they otherwise would do. I am convinc-

ed, that if the capsule were so completely lacerated as to leave the bone free, the limb and toes in this luxation would invariably be turned outwards; and on some rare occasions we actually find this to be the case, which I ascribe to a more extensive laceration of the capsule than usually occurs. If this reasoning be correct, in luxation upwards upon the dorsum ilii, the limb may be either turned inwards or outwards, although for the cause we have assigned it is generally turned inwards; but, independently of the position of the limb, this species of luxation may be always discriminated from fracture of the neck of the thigh bone, by the immoveable state of the limb, and by the great force requisite to extend it.

2nd, The second species of luxation downwards and inwards into the thyroid hole, does not occur quite so often as that upwards and outwards. It arises chiefly from the foot slipping outwards in falls, more especially under heavy weights. At the lower and inner edge of the socket, there is a deficiency of bone, and even the cartilage which supplies the defect is less deep at this place than any part of the margin. Hence the bone is more easily displaced in this direction, and the only reason for luxation upwards and outwards being more frequent than that downwards and inwards, is that in the leaps, falls, and other accidents which affect this joint, the force is more frequently applied in the upward direction than any other. In this luxation, the capsule is lacerated at its

lower and inner part; the round internal ligament is always torn, because the force is suddenly applied; and the head of the bone rests upon the external obturator muscle. The signs which characterize this luxation are decisive. The limb is lengthened, the knees are considerably separated and gently bent, the leg, foot, and toes are turned outwards, and the body is also bent. Farther, the thigh bone can be traced along its outer edge half way above the knee, after which it cannot be felt; there is a hollow in the situation of the great trochanter; the adductor muscles are lengthened, and can be traced tense from the pubis half way down the thigh; and the head of the bone from its superficial situation, can be distinctly felt in the groin. Lastly, the limb can be bent upon the pelvis, but cannot be brought towards the other knee; and if attempts are made to do so, there is excruciating pain. The bent state of the knee in this luxation, arises from the tension of the hamstring muscles; and the elongation of the muscles implanted into the trochanter, which is a natural consequence of the new situation of the head of the bone, turns the whole limb outwards.

3d, The third direction in which the head of the thigh bone may be luxated, is upwards and forwards upon the pubis, where it joins the ilium. This luxation is extremely rare. When the accident does happen, it most commonly arises from the body being driven forcibly back, or from falls backwards while the lower part of the limb is fix-

ed. The injury is at once detected by the shortening of the limb, by the foot and toes being turned outwards, by the limb being immoveably fixed as in other luxations,—exciting great pain when attempted to be moved, and, above all, by the head of the bone being distinctly felt resting under Poupart's ligament.

4th, The fourth and last direction in which the thigh bone may be luxated, is directly backwards into the sacro-sciatic notch. This luxation so rarely occurs, that many surgeons have never an opportunity of seeing it during a long and extensive practice. It is produced by the head of the bone being forcibly impelled against the back part of the capsule, while the thigh is bent upon the pelvis and the knee carried inwards. The signs of this luxation are the following,—the limb is a little shortened, the foot and toes are turned inwards, the knee is a little bent, the trochanter major is placed farther back than its natural situation, although turned towards the acetabulum, and, if the patient is of a spare habit, the head of the bone can be felt lodged in the sacrosciatic notch,—more especially upon bending the thigh, which can be done to a certain extent.

In all luxations of the hip joint, reduction, if delayed, is very difficult, and after a time impracticable,—because a new socket is formed with which the head of the bone is connected by a capsule, and the old acetabulum fills up. I believe,

however, that the reduction may always be effected at first.

1*st*, In the first species of luxation upwards and backwards upon the dorsum ilii, the most powerful and most successful method of reduction with which I am acquainted is the following.—Let the patient be placed upon a hair matress, laid upon a firm table; let him be laid over upon the side opposite to that which is dislocated; a strong hook or ring is then to be screwed into a wooden pillar, a wall, or partition, at the head of the table; the surgeon now takes a thick wooden roller, from two or three feet in length, round which he passes several rolls of flannel or linen, till it is sufficiently bolstered so as not to hurt by its pressure; in this state it is to be passed betwixt the patient's thighs, and so placed that the defended part may press upon the perinæum; a rope or leathern strap is now to be passed through the ring in the wall, and each end fastened to one of the ends of the roller, so that when the limb is extended, a powerful counter-extension may be made, and the patient effectually secured. If the roller makes any undue pressure, or excites pain, a small feather pillow may be placed betwixt it and the perinæum.* When the

* This manner of fixing the patient by the roller in luxation of the hip joint, was much used in the Royal Infirmary of Edinburgh about 25 or 30 years ago, particularly by Mr Latta, and always with success.

patient is thus fixed, a leathern belt is to be buckled round the thigh immediately above the condyles, and the pullies hooked on precisely in the same manner as already recommended in the reduction of the luxation of the shoulder joint, and represented in plate seventh. The knee is to be bent, and the extension begun and continued steadily and slowly, in the direction in which the limb has been placed by the dislocation. During the extension, the surgeon places his right hand on the great trochanter, and, when the head of the bone has been brought near the socket, with his left hand he lays hold of the knee, and rolls it outwards, so as to turn the head of the bone inwards, by which means it slips into the socket.—If the pullies and the rest of the apparatus now recommended are not at hand, the accident has recently happened, and the patient is not very muscular, the luxation may be reduced by laying him on a firm bed on the sound side, rolling cloths round the bed post, placing it betwixt his thighs, bringing him forwards till the perinæum, pubis and ischium press against the post, and then making a powerful extension by several assistants pulling at sheets or tablecloths fastened above the knee,—the surgeon at the same time observing to roll the knee out, when the head of the bone is brought on a level with the acetabulum. When the patient is very muscular, we must repeatedly, although gently, in order to weaken the power of the muscles, renew the ex-

tension again and again, or have recourse to blood-letting and the warm bath, with small dozes of tartarized antimony.

2nd, In the second species of luxation, viz. downwards and inwards into the thyroid hole, the reduction is in general easily effected. It may be laid down as a fixed principle, that whatever joint is easily luxated, is for the same reason easily reduced. This reasoning will apply, not only to the great joints of the shoulder and hip, but to every other joint, each in its degree. Therefore because the head of the thigh bone is carried more easily inwards over the brim of the acetabulum, this species of luxation ought to be more easily reduced, and this natural conclusion is verified by experience. Little extension is required, and the chief circumstance to attend to in the reduction, is to raise up the head of the bone from the thyroid hole and carry it backwards towards the acetabulum. The reduction should be first attempted in the following way. The patient must be laid upon a hard bed, a firm table, or the floor, upon the sound side; the surgeon then places his knee upon the patient's haunch, to keep it down,—while an assistant keeps down the knee with his hands; the surgeon now clasps with his hands the upper part of the thigh, and with his whole force attempts to pull the head of the bone up from the thyroid hole; or to give him a greater purchase, he passes a table-napkin round the thigh, knots it, and carries the loop over his neck,

and then resting with his hands upon the pelvis, he endeavours to raise up the head of the bone and bring it towards the socket,—at the same moment that he does this, the assistant who holds down the knee should turn it inwards, which will assist in carrying the head of the bone outwards and favour the reduction. By pursuing this plan we shall often succeed; but if this should not be the case, a certain degree of extension must be employed,—and for this purpose we have recourse to the roller and pullies, as recommended for the luxation upwards and backwards. When the extension has been continued for some time, so as to raise the head of the bone from the thyroid hole, an assistant should lay hold of one end of the roller, another assistant the other end, and by this means they should gently lift up the head of the bone towards the acetabulum,—at the same time that the assistants do this, the haunch must be held down, the extension suddenly dropt, and the surgeon carry the knee inwards. If the luxation is recent, this mode of procedure will never fail to effect the reduction.

3d, In the third species of luxation, upwards and forwards upon the pubis, a greater degree of extension is required than when the head of the bone is situated in the thyroid hole; and the extension should be made by carrying the thigh a little backwards, as that direction more directly leads the head of the bone to the acetabulum. The patient is to be laid upon his sound side, the

pelvis fixed by the counter-extension by means of the roller or bedpost,—the pullies applied immediately above the knee, the knee bent and the pelvis held down. The extension is now to be made by carrying the thigh backwards, and, when it has been kept up for a little time, the surgeon embracing the neck of the bone with his hands, or with a napkin slung round his neck, endeavours to lift it into the socket. This luxation is in geral easily reduced, as there are no spines or processes which can entangle the head of the bone.

4th, The fourth species of luxation, where the head of the bone is driven backwards into the sacro-sciatic notch, is the most difficult of all to be reduced,—not only because it is carried far from the acetabulum, but because it is placed so far below the margin of the socket, that it is difficult to raise it to the same level. The patient must be placed and secured, and the pullies applied, as in the other luxations. The thigh must be bent so far upon the pelvis as to form nearly a right angle with it, and the extension conducted by carrying the limb in a direction obliquely across the middle of the sound thigh. The surgeon stands before the patient, and, when the extension has been for some time continued, he should attempt by means of the napkin carried round the thigh, and suspended by his neck, to lift up the head of the bone and bring it forwards over the margin of the acetabulum. To prevent a repetition of the dis-

placement of the reduced bone, the thighs should be tied together, the patient confined for a few days to bed, and the utmost caution adopted when he returns to his usual employments.

LUXATION OF THE KNEE JOINT.

The knee joint is formed by the femur, tibia, and patella. The fibula is below the joint, and does not enter into its formation. The knee joint is the most superficial joint of the body, being composed only of two flat bones opposed to each other; but notwithstanding the shallowness of the joint, and the strains to which it is perpetually exposed in all the violent movements of the lower extremity, it is less frequently luxated than any other joint, as it is firmly secured by numerous and strong ligaments.

1st, The articulating surfaces of the bones are covered with a smooth cartilage, by the lubricity of which the whole glides with ease. *2nd*, The top of the tibia is a little concave, and this concavity is increased by two semilunar cartilages, which are thicker at their outer edges, and which are placed one on each side, interposed betwixt each condyle of the femur and the hollow on the top of the tibia. By their mobility the joint is rendered more free and easy in its motions. *3d*, There are two internal ligaments which decussate each other, and the chief use of which is to pre-

vent the joint from being too much bent or over extended; and when any force is suddenly applied, they assist most powerfully in retaining the heads of the bones, and in preventing displacement. *4th,* There is a strong capsule which surrounds the whole joint. It comes down from the thigh bone above the condyles, and from the sides of the patella, and is implanted all round into the head of the tibia. This capsule is strengthened at the sides by lateral ligaments, which are more distinctly marked than in any other joint; and posteriorly by a strong ligament which comes down from the external condyle, runs obliquely across the back of the capsule, and is inserted into the head of the tibia. Besides the capsule being strengthened by accessary ligaments, it is farther assisted by the expansion of the flexor and extensor tendons, and above all it is covered and made firm by the common fascial expansion which covers the knee.

From the structure of this joint great force is required to luxate it. The luxation is seldom complete, but when this is the case the injury done to the soft parts is often so great that it is complicated with an external wound, or the inflammation and swelling which follow lay the foundation of a disease that ultimately ruins the joint.

Luxation of the knee is extremely rare, although it ocasionally presents itself in consequence of extreme violence. It may be luxated laterally,

backwards, or forwards. When luxated laterally, the luxation, like that of the elbow joint, from the extent of the articulating surfaces is always incomplete. It is most commonly luxated laterally either inwards or outwards, and the head of the tibia is sometimes driven backwards, very rarely forwards. The accident is always very serious from the extent of the laceration of the soft parts, and from the inflammation and swelling which are apt to ensue. There is not only violent pain and inability to move the leg, but the injury is at once apparent from the distortion.

This luxation is easily reduced. One assistant grasps the thigh, while another extends the leg, when the surgeon forces the head of the tibia into its place. After the reduction two splints should be placed along the sides of the knee, and the limb laid out on a pillow; leeches and saturnine lotions should be applied; the most rigid antiphlogistic regimen should be enjoined; and if the patient be in the vigour of life he should be largely blooded from the arm, to avert inflammation.

LUXATION OF THE PATELLA.

The patella properly speaking can only be luxated laterally, either inwards or outwards. It cannot be drawn upwards so as to uncover the joint without a rupture of the ligament by which

it is connected to the tibia. This is an accident of a different nature, which will be treated of in its proper place.

The lateral luxation never takes place when the knee is bent, because at that time the patella is firmly braced down and confined in the hollow betwixt the condyles of the thigh bone. It always occurs when the leg is more or less extended, and is more apt to happen when the extension is complete.

From the formation of the condyles one should imagine that the patella would slip more easily inwards than outwards, as the inner condyle is less elevated. Accordingly the generality of writers describe the internal luxation as the most frequent, but the practical view is different from the theoretical—the luxation taking place much more frequently outwards than inwards. The more frequent occurrence of outward luxation arises from the position of the patella with regard to the thigh bone, in the extended state of the joint. In this situation the patella does not lie in the centre of the axis of the bone, but inclines more outwards; besides its outer edge is more elevated than its inner, by which it glides more easily along the outer condyle than the inner.

The inclination of the patella to slip more easily outwards than inwards may be at once ascertained by a person extending the leg and moving the bone from side to side. Independently of the acute pain, in this luxation, the patient is incapa-

ble of bending the knee, and the patella forms a distinct tumour upon the outer or the inner condyle, according to the nature of the luxation.

It is easy to reduce this luxation. The leg must be completely extended, and the patient placed in a sitting posture to relax the muscles, when the bone will return to its place almost spontaneously; if not, by pressing on its outer edge the inner edge will be so raised that it can be easily forced back. This accident is in general followed only by a slight inflammation and swelling, which if disposed to rise high, must be repressed by leeches and saturnine lotions.

LUXATION OF THE ANCLE JOINT.

The ancle joint is formed solely by the astragalus with the tibia and fibula. The fibula passes the end of the tibia and forms the outer ancle, and the tibia terminates in a pointed process which forms the inner ancle. The semicircular head of the astragalus is completely received within the joint, and the process of the tibia and the end of the fibula go so far down as to embrace the sides of this bone, forming a complete hinge joint, and one of the strongest in the body.

The ligaments of this joint are the same as in every hinge joint. 1*st*, All the articulating surfaces are covered with cartilage, and a capsule arises from the ends of the tibia and fibula all

round, and is inserted into the fore, the back part, and sides of the astragalus. *2nd*, This capsule is strengthened by lateral ligaments, which are stronger and more numerous on the external than on the internal side,—hence in luxation, when the fibula is fractured, the extremity of this bone is so strongly retained that it in general keeps its place and the upper part only is carried along with the tibia. *3d*, The internal lateral ligament is of a triangular form called the deltoid ligament, which coming down from the tibia is expanded upon the astragalus, os calcis, and naviculare; and, independently of strengthening the connection betwixt the tibia and these bones acts also as a check-band preventing the foot from being too far extended or too much bent.—*4th*, Besides the lateral ligaments there are transverse ligaments both on the fore and back part of the joint, connecting the bones of the leg closely together and preventing their diastasis or separation.—And *5th*, the ancle joint is farther strengthened by the tendons of the extensor and flexor muscles of the foot and toes, which cover it on all sides.

The bones of the inner and outer ancle go so far down upon the sides of the astragalus, and inclose it so firmly, that it cannot vaccillate nor be luxated to either side without a fracture of the tibia or fibula; and the security afforded by the ligaments is so great, that there can be no luxation forwards nor backwards without the most

dreadful violence. The foot may be luxated inwards or outwards, backwards or forwards. It is most frequently luxated inwards, and in this case is always complicated with fracture, generally of both bones. The accident most commonly happens from the foot being twisted outwards in leaping, or from its slipping outwards in falls, the weight of the body in this case being thrown upon the inner ancle. In this luxation the inner ancle or process of the tibia is fractured; there is distinct crepitus; the forepart of the foot is turned inwards, the sole outwards, and its inner edge rests upon the ground; the fibula is fractured two inches or more above the ancle, but, as the external lateral ligaments remain entire, the fractured extremity of the bone retains its connections; the process of the tibia carried inwards by the astragalus, forms a tumor at the inner ancle; there is acute pain, with inability to move the foot, and marked distortion; and the capsular, deltoid, and transverse ligaments are lacerated. In one case which came under my care the laceration of these ligaments was so extensive that the toes were completely turned round to the inner ancle.

In the reduction, the patient must be placed upon a couch or firm bed, and the knee bent to relax the gastrocnemii muscles; one assistant then grasps the thigh firmly above the condyles to make the counter-extension; another lays hold of the heel and forepart of the foot, and extends

in the direction of the leg; while the surgeon pushes the bones into their situation. After the reduction, which is easily effected, two splints must be applied and fastened with tapes or the eighteen tailed bandage, and the limb either laid on its outer side with the knee bent, or upon the heel resting in the machine already recommended for fractures of the thigh and leg. When the limb is placed upon the heel, the fractured bones are more easily retained in their situation, but it requires considerable attention to prevent the foot turning outwards. This tendency to turn outwards, however may be most effectually counteracted by fixing the foot in the position recommended for fracture of the fibula immediately above the ancle. Should much inflammation and swelling supervene, the bandage must be undone, the splints removed, and leeches with saturnine lotions applied. After the inflammation has subsided, the splints may be either reapplied, or, after placing the foot as nearly as possible in its natural situation, it may be bolstered up with pillows. In the management of luxation of the ancle joint with fracture of the bones, our chief care must be directed to keep the foot in a line with the tibia, and to place the ends of the fractured fibula as nearly in contact as possible. This must be particularly attended to, as the foot has a tendency to turn outwards, in which case the one end of the fibula does not remain in apposition with the other; and consequently when the cure

is effected, there is not only considerable distortion from the foot inclining outwards, but the limb is actually shortened. To obviate this defect, the foot must be kept inwards as we have just now directed.

The luxation of the foot outwards most frequently occurs in consequence of the foot having turned inwards in leaping, and the whole weight falling upon the outer ancle; or from the foot being thrown in that direction under the body in falls. Here all the signs are the reverse of those in the luxation inwards,—the fore part of the foot being turned outwards, the sole inwards, and the foot resting upon its outer edge; and the tibia is fractured at the inner ancle; the capsular and external lateral ligaments are more or less torn; and the fibula is generally fractured near the joint; the astragalus pressing the fractured portion outwards, and forming a tumour at the inner ancle.

In the reduction, the patient and the limb are to be placed in the simple position as in luxation inwards; the extension and counter-extension are to be made by the assistants; the bones are to be pushed into their natural situation by the surgeon in the same manner as directed in that case; and after the reduction is effected, the whole management is to be conducted upon the same principles.

When the foot is luxated backwards, the accident generally takes place from desperate leaps

or falls upon the feet, the knees being then bent and the body thrown forwards. In this luxation, the heal is lengthened, the foot shortened, and the toes are turned downwards; the articulating head of the astragalus escapes backwards from the scaphoid cavity of the tibia; and this bone now rests upon the os naviculare and anterior part of the astragalus; the fibula is generally fractured about three inches above the ancle, the lower portion forming the outer ancle remains attached by its ligaments to the tarsal bones, and the upper portion of the bone is carried forwards with the tibia; the capsular, deltoid, and transverse ligaments are torn; there is acute pain; the foot is immoveable; and there is great distortion of the foot and ancle.

The patient and the limb are to be placed as in the two other luxations,—one assistant makes the counter-extension above the knee, and another in making the extension must pull in the direction of the leg, at the same time bringing the foot forwards, while the surgeon pushes the tibia backwards. When the reduction is effected, the limb must be placed and treated as in the other luxations of the foot.

The fourth direction in which the foot may be dislocated is forwards; but this accident more rarely occurs than any of the other three species of dislocation. It happens from falls backwards while the foot is fixed. It is most commonly combined with fracture, more especially of the

fibula; the capsular, deltoid, and anterior transverse ligaments are ruptured; and the tibia is carried backwards, so as to rest upon the os calcis; the foot is lengthened, and the heel shortened; the astragalus forms a tumour on the upper and fore part of the foot; and the distortion is so marked as at once to characterize the nature of the injury.

In reducing this luxation, extension and counter-extension are to be made as in the luxation backwards,—only the assistant in the extension instead of bringing the foot forwards pushes it backwards, while the surgeon brings the leg forwards. After the reduction, which is in general easily effected, the same treatment which we have already recommended must be pursued.

COMPOUND LUXATION OF THE ANCLE JOINT.

Any of the luxations of the ancle joint which we have enumerated may be complicated with a wound of the integuments, forming compound luxation; but this circumstance is most apt to occur when the luxation is lateral. The bones which most commonly protrude are the tibia or astragalus or both; but if the foot is luxated outwardly, the fibula also sometimes protrudes. In the treatment of compound luxation of the ancle joint, our first object is to arrest any hæmorrhagy by securing the bleeding vessels. After

this is effected, we clean the wound by washing with warm water; we remove all extraneous bodies or loose pieces of bone; and then reduce the bones, as in simple luxation, by relaxing the muscles and by extension. If this is found to be impracticable, from the smallness of the opening, we have recourse to the practice advised under compound luxation,—securing the limb in splints; and lastly, we adopt the local and constitutional treatment therein recommended*.

LUXATIONS OF THE BONES OF THE FOOT AND TOES.

THE bones of the foot, like those of the hand, are connected together by articulating surfaces, and capsular and lateral ligaments. The motion is very limited, but yet so constant that the joints are never obliterated. If the motion of these bones were extensive they would be frequently luxated, as they sustain the weight of the whole body in leaps and falls upon the feet.

But there is rather a diffused elasticity than extensive motion; and, while they yield so as to elude any violent shock, they are so strongly connected together by numerous ligaments that they form as it were but one bone.

Notwithstanding the firm connection of the

* For the best description that has been hitherto given of luxations of the ancle joint, see a paper by Mr Astley Cooper in the Surgical Essays by Cooper and Travers, Part 2d.

bones of the tarsus, they are sometimes luxated. The astragalus is rarely separated from the os calcis, but it frequently escapes from its articulation with the os naviculare. In this case it is most commonly thrown upwards, and forms a tumor on the fore part of the foot; sometimes the bone is forced through the integuments; and sometimes these are so much stretched that they immediately inflame, the skin ulcerates, and the astragalus projects. This accident occurs when the toes and metatarsus are fixed, while the person falls backwards. The luxation is very difficult to be reduced, but it must be attempted provided there does not exist any extensive inflammation. It is done by one assistant securing the lower part of the leg and heel, while another powerfully extends the foot,—the surgeon at the same time forcing the projecting bone downwards and backwards into its place. Cases have occurred where the astragalus has been forced through the integuments, and so extensively disengaged from its connections that the surgeon has removed it. The tibia has then fallen down and rested upon the os calcis, and the patient has recovered sometimes with anchylosis, at other times with a joint tolerably free*. The os calcis is sometimes luxated

* See Medicine Eclairée par les Sciences Physiques par Fourcroy, Tome 2. p. 60. Bulletins De L'Ecole De Medicine, Tome 3. p. 238, and Surgical Essays by Messrs A. Cooper and Travers, Part 2. p. 162.

from the os cuboides. It may be carried upwards along with the astragalus, or it may be displaced laterally. In this last case the luxation occurs most frequently outwards. The accident is attended with great pain, and, if there is not much swelling, with distortion which can be traced with the fingers. The bone is to be reduced, like the astragalus, by extension and counter-extension, and then forcing it back into its place.

The remaining bones of the tarsus are rarely luxated, and the metatarsal bones seem to be too firmly fixed to the tarsal for this accident to happen to them.

The toes are so short that they cannot be so liable to luxation as the fingers; but, when the accident does occur, it is to be treated in all respects as already recommended for luxation of those bones.

LUXATION OF THE RIBS.

From the manner in which the ribs are connected with the vertebræ, it will at once appear that no luxation of them can take place either upwards, downwards or outwards. It is also evident that they are so firmly attached to the vertebræ by a double articulation, secured by numerous ligaments, that they could not be displaced inwards by a twist. To effect this displacement, the application of external violence would be re-

quired; and the ribs are so long and slender in themselves, that it is probable, upon the operation of such violence, fracture would follow before the joint could yield. I therefore do not believe that luxation of the ribs at their vertebral articulation ever takes place, although this luxation is described by many writers on Surgery; but from the manner in which the ribs are connected with the sternum, luxations at their sternal extremity may sometimes present themselves. Their cartilages are joined to the sternum, not by symphysis, like the pubis, but by joints with regular capsular ligaments, and therefore each is liable to luxation.

In the course of my own practice I have met with two cases of luxation at the sternal articulation of the ribs. The one was in a lady and occurred during labour. After her accouchement she complained of pain towards the lower and left side of the sternum, which was increased upon lying down, with slight difficulty of breathing; and, upon the application of the hand, the extremity of the rib could be felt raised. The other luxation was in a young girl. It happened from drawing a cork, and in the moment of the accident, she was conscious of something giving way. There followed the same symptoms, pain and difficulty of breathing, increased upon lying down in bed, with swelling. The reduction in both cases was easily effected. I desired the pa-

tients to take a full inspiration; I then forced in the extremity of the cartilage; applied over it an adhesive plaster spread on thick leather; then laid on a firm compress; and passed a roller, with a moderate degree of tightness, round the chest. In a short time both patients were completely cured.

The napkin and scapulary bandage, delineated in page 492 of Volume 1st, is well adapted for this accident.

LUXATION OR DIASTASIS OF THE PELVIS.

The bones of the pelvis can be separated from each other only by extreme violence. A separation has sometimes taken place in consequence of tedious and difficult labours. Thus the os coccygis has been forced backwards by the pressure of the child's head, and the pubic bones have been found separated at the symphysis.

The separation at the symphysis was once thought to be a provision of nature to facilitate labour, and upon this doctrine was founded the Sigultian operation, which consists in the divison of the cartilage connecting the pubic bones; but when we consider the very little increase of size that such separation would give to the pelvis; the rareness of the occurrence, and the total and long continued lameness which always ensues, as is exemplified by the cases of Spence, Denman, and

other writers on midwifery, this operation must be held as totally inadmissible and the separation can be viewed only in the light of a formidable disease. When diastasis of the bones of the pelvis occurs in consequence of external violence, the force required to effect it is so considerable that the injury is seldom confined to them, but extends to the contained viscera, or at all events the accident is apt to be followed by extensive inflammation terminating in suppuration or gangrene. There is related in the ninth Volume of the abridgment of the Philosophical Transactions, a case in which, in consequence of a sudden and violent twist on horseback, the pubic bones were wrenched asunder to the distance of four inches, and the bladder was rent to the extent of half an inch a little above its neck. In the moment of the accident the patient felt the horrible sensation of being as it were split asunder, the urine escaped into the scrotum, distending it to such a degree as to bury the penis in its substance. The parts fell into gangrene, and the patient died on the morning of the sixth day. A similar case is detailed in the 10th Volume 12mo. of the Memoirs of the Royal Academy of Surgery. A young country man experienced a separation of the pelvic bones at their sacro-iliac junction, in consequence of a sack of wheat falling upon him. Although he walked about for two or three days after the accident, in eight days his lower extremities became paralytic, and he could not retain

his urine or fœces,—in nineteen days he died, and upon dissection the ilium of the right side was found separated from the sacrum, and projecting to the extent of three inches. There was also found within the pelvis an extravasation of pus, with other marks of inflammation.

Although separation of the bones of the pelvis be a rare occurrence, these cases show that such an accident sometimes takes place. It is characterized by the pain, which is particularly acute upon moving the lower extremities, and upon this motion there is mobility at the injured part; the patient can neither stand nor walk, especially when the separation is at the symphysis; and if the accident is not attended with much swelling, or there is no great thickness of the soft parts, the displacement of the bones may be traced with the fingers.

When separation of the bones of the pelvis does occur, they must be replaced as accurately as possible, and the accident treated like fracture. The patient must be placed in an easy posture, the pelvis firmly bound up by napkins and circular bandages, and rest enjoined by confinement to a bed or sofa. At the same time, as in fracture, he must be blooded occasionally, according to circumstances, placed upon a low diet, and the catheter and glysters must be resorted to, if required.

The os coccygis, from its projecting and being unsupported, may be displaced backwards or for-

wards. It may be forced backwards by the head of the child in its passage through the pelvis, or it may be driven inwards by a kick, fall or blow. It will in general be easily replaced by the introduction of the fore and middle fingers into the rectum, while the surgeon co-operates with his other hand placed externally. When reduced, it will in general keep its place, but if this should not be the case, it must be retained by a compress and the T bandage.

CHAP IX.

DISEASES AND ACCIDENTS OF THE SPINE.

GENERAL REMARKS ON THE STRUCTURE OF THE SPINE.

THE spine is composed of 24 pieces, and is arranged in three great divisions—the neck, back, and loins. The vertebræ of the neck are seven in number; they are smaller than those of the back or loins, have a greater degree of motion, and suffer from sudden violence more frequently than any other part of the spine. The vertebræ of the back are twelve in number, they are larger than those of the neck, but smaller than those of the loins. They are more closely connected than any other part of the column, their spinous processes overlap, their joints are very secure, and all motion in them is suppressed by the manner in which they lock into each other, and by their connection with the ribs. The vertebræ of the loins are five in number,—they are larger and stronger than any of the other bones of the spine,—

their articular processes are perpendicular and deep, to prevent luxation,—their spinous processes are horizontal and free,—and a thicker cartilaginous substance is interposed betwixt their bodies to permit those free motions that are required in this part of the vertebral column.

Each vertebra consists of a body and seven processes. The body is light and spongy, of the same cancellated structure as the bones of the carpus and tarsus; all its surface is perforated with delicate vessels; and these bones often inflame and ulcerate throughout their whole substance down to the spinal marrow, producing curvature of the spine and its consequences. Of the seven vertebral processes, four are articulating, two superior and two inferior, connecting each bone with the one immediately above and below it; these processes, are oblique in the neck, partly so in the back, and perpendicular in the loins. Two are situated transversely, called the transverse processes. These serve the purpose of a mere lever in the loins, they are perforated in the neck to give passage to the vertebral artery, and in the back they are appointed to a different office. In this case they do not act as a lever, for there is little motion, and what there is, is not lateral; but they support the angle of the rib, give it a second joint, and regulate its motion. The seventh and last process projects backwards, and is termed the spinous process. It is short, flat, and broad in the loins; long, aquiline, and

bent down in the back; and short, bifurcated, and direct in the neck. To the transverse and spinous processes, more especially in the neck and loins, are attached those muscles which move the spine; and by this lever they raise the body with great power.

The junction of the processes with the body of the vetebræ forms a canal of a triangular shape, in which the spinal marrow is contained. This canal is lined with a tough ligamentous substance, which connects the bones together and forms a strong theca or sheath for the marrow. As the marrow is a continuation of the brain, it is liable to be affected in a similar manner from external injury; and its nerves are chiefly distributed to those less important organs which are not animated by nerves from the brain. A frequent consequence of its being injured is palsy, which must be more or less formidable, as the compression is situated higher or lower in the spine, and involves a greater or less range of nervous energy.

From the vertebral column thus consisting of two structures, the diseases and accidents to which it is exposed are of two kinds,—1*st*, As they have reference to the bone merely. 2*dly*, As they involve the spinal marrow. The first class may lead to curvature of the spine, or ultimately affect the general health. The second class is always attended with a train of very distressing symptoms, which sooner or later proves fatal.

SECTION I.

DISEASES OF THE SPINE.

The diseases of the spine are both congenital and accidental. From the obscurity of the symptoms which attend them in their early stage, and from the distressing consequences which are apt to ensue, they are particularly interesting. The malady has in general made considerable progress before its existence is suspected; the patient does not at first complain of pain in the site of the disease, but applies for relief for paralysis of the lower limbs or pelvic viscera; and the surgeon is from thence led to examine the spine. Sometimes he can at once detect the seat of the complaint, at other times not, and although he is able to effect a cure, there not unfrequently remains, even in the most favourable circumstances, permanent distortion.

SPINA BIFIDA.

Spina bifida is a malconformation or congenital disease. It is a dropsy of the sheath of the spinal marrow, and consists of a tumor situated upon some part of the spine, most commonly upon

the lower part of the loins or upon the sacrum, more rarely upon the back, and seldom on the neck. Ruysch says, that the sacrum is the most common seat of the disease, but it is generally understood to be more peculiar to the loins. It is attended with an incomplete state of some of the vertebræ. Each of the vertebræ in the child, where the bones are yet unformed, consists of three pieces, one for the body and one for each side of the arch. These form the canal for the spinal marrow. The spinous processes at this time are entirely a-wanting, and when formed they are joined by an intermediate cartilage. Sometimes there is a deficiency of bone at this part, and in its place there is a tumor of an elastic feel, varying in size from that of a walnut to that of an orange, and of the natural colour of the skin. At the time of birth the tumor is generally pellucid, permitting us to see through it when a lighted candle is presented, as through the sac of a hydrocele, but it soon becomes opake;—the sac is formed by the sheath of the spinal marrow; from there being a deficiency of bone, the pressure of the fluid makes the sheath herniate or protrude through the opening; and the spine appears as if it were cleft or separated, hence the name of the disease. The tumor is compressible, and by pressure the fluid can be made to disappear to a certain extent. This pressure has, in some cases, such a marked effect upon the rectum, that the fæces are immediately ejected.

Children afflicted with spina bifida are generally puny and weak; their lower extremities are feeble, and they at last become paralytic. The stools and urine are either passed involuntarily, or obstinately retained. The tumor increases rapidly after birth; often the skin inflames; the tumor, assuming a purple hue, gangrenes and bursts; a thin limpid bloody water is discharged from it; and the child dies in the second or third week after.

This is the common course of the disease, but it sometimes happens that the skin does not inflame but continues entire, the tumor remains stationary or nearly so,—the child lives and even thrives. Where great care has been taken, the tumor has continued entire for eighteen months or two years. Bohnius mentions a case where the child lived till it was ten years old, and Warner relates another where the patient lived till he was twenty. There are other cases on record of like duration of the disease. When the child lives, its lower extremities continue small and paralytic, the upper parts of the body only grow, but at last it begins to decline and dies.

This disease has been ascribed to the water of hydrocephalus descending by gravitation along the inside of the sheath of the spinal marrow, and presenting betwixt two of the vertebræ, or where there was a deficiency of bone; but this cannot be its origin, because the fœtus lies in the womb

with the head downwards. However, spina bifida is an original disease of the nature of hydrocephalus, and is not unfrequently complicated with that disease. It seems to be a dropsy of the sheath of the spinal marrow, as hydrocephalus is of the dura mater,—both destroy by compression, and both prove fatal when the tumor is largely opened. When the skin can be made to support the distension, the child lives longer than under hydrocephalus; but it is very apt to inflame and ulcerate, in which case the child dies.

In congenital hydrocephalus the brain is commonly found quite dissolved, and in spina bifida, the spinal marrow in the seat of the disease is also frequently in a similar state.

TREATMENT OF SPINA BIFIDA.

Two methods of treatment have been proposed in this disease,—the one palliative, and the other with the hopes of effecting a radical cure.

The palliative method is by support, and the radical cure by puncture. Spina bifida is so frequently fatal, that we generally have recourse to the palliative treatment. If opened with a lancet intentionally, to evacuate the fluid, or by mistake for an abscess, the child does not live many hours. In proportion as the skin can be kept entire and the swelling resisted, life is prolonged. Whatever frets the skin does harm. The best general

practice is to anoint the tumor gently with a little olive oil, then to apply a compress of soft cotton cloth, or a piece of fur with a roller moderately firm. When this has been worn for a time, if the tumor can be made to recede within the canal of the spine, and the pressure is not productive of bad consequences, such as coma, convulsions, or paralysis of the pelvic viscera and lower extremities, a soft truss may be applied and worn perpetually. This will be found to check the progress of the disease and prolong life, as is exemplified in a case detailed by Mr. A. Cooper in the 2d volume of the Medico-Chirurgical Transactions.

When the tumor is small, when there is no affection of the brain nor paralysis of the pelvic viscera or lower extremities, the case is favourable for attempting the radical cure, and this is to be effected by puncture. The fluid must be evacuated by puncturing the tumor with a fine couching needle, or with a common sewing needle; and after it is discharged, a small piece of court-plaster or gold-beaters leaf is to be applied with a compress and roller. When the fluid again collects, it must be again punctured, and the puncture renewed as often as occasion requires. By pursuing this treatment, the sac sometimes inflames and adheres, and the parts are so far consolidated as to produce a permanent cure. This has occurred in a few cases under the care of Mr. A. Cooper, and in one case which fell un-

der my own observation; but spina bifida is so frequently complicated with hydrocephalus, and accompanied with paralysis of the lower limbs, and of the urinary bladder and rectum, that it must be accounted an incurable disease.

INFLAMMATION, CARIES, AND INCURVATION OF THE SPINE.

The spongy structure of the bones of the spine and its numerous ligaments, render it peculiarly liable to scrophulous inflammation. In those constitutions in which a scrophulous diathesis prevails, a twist or a blow often lays the foundation of a formidable disease. Although the vertebræ be neither broken nor displaced, the external injury excites such a degree of inflammation and swelling in the ligaments, theca vertebralis and other soft parts, as to compress the spinal marrow, and to a certain extent paralize the abdominal viscera and lower limbs. The inflammation extends to the bones, which ulcerate; the intervertebral substance wastes; the adjoining bones are thus displaced; the vertebral column becomes distorted; the spinal marrow is gradually more and more compressed; and the patient remains deformed, and is almost paralytic. In the progress of the disease, the lower limbs not only lose their strength but also their plumpness, and the growth is checked, or at least advances only in

the upper parts of the body. If the presure on the spinal marrow is considerable, or the irritation great, the patient dies, but this is not often the case. The disease seldom proves fatal, the parts accommodate themselves to the state in which they are to remain, and they in like manner recover slowly as the paralysis came slowly on.

This disease of the spine is frequently referable to a blow, and the injury often long precedes the symptoms of disease; but although it can be sometimes traced to external injury, it is not the necessary consequence of a blow, otherwise the disease should occur as frequently in other countries as in this. In the same manner as a blow upon the knee in a scrophulous constitution will induce white swelling, so in a similar habit a blow upon the spine will occasion inflammation, caries, and distortion.

Both sexes are equally liable to be attacked with this disease, and adults as well as children, although, like other scrophulous diseases, it is rather peculiar to early life, and occurs most frequently in weakly children. It may occur in the neck, back, or loins; but most generally happens in the back; and it is worthy of remark that although the disease be situated high in the spine, the arms are seldom if ever affected with palsy, as the lower extremities only suffer. Inflammation, caries, and incurvation of the spine, are generally ascribed to a blow or a fall; yet in the majority

of cases, no cause can be assigned, or the disease is produced by an injury so slight as not to be known. When an external cause can be assigned, there is reason to believe that its chief operation consists in calling forth the constitutional predisposition, which is scrophula.

In the commencement of the disease, the soft parts only are affected, the ligaments connecting the veterbræ, the inter-vertebral substance, and theca vertebralis gradually inflame and thicken and compress the spinal marrow; the lower limbs become weak; this weakness gradually increases; in walking the patient rolls from side to side, his gait is awkward, and the step is unsure; there is a tightness across the upper part of the abdomen; the belly is costive, the urine is generally retained, or the bladder is emptied with difficulty; and, the compression increasing, the patient in the progress of the disease, loses entirely the use of his lower limbs. The effects of this compression are most conspicuous in the lower limbs, although the thoracic and abdominal viscera are always more or less impeded in their functions, in proportion as the disease is situated higher or lower in the spine. In this early stage, the disease is entirely confined to the soft parts, there is no bump or distortion, seldom indeed any pain to direct us to its seat; but if the fingers be drawn firmly along the course of the spine, the patient shrinks and complains of pain, when the inflamed parts are pressed upon.

The disease advancing, the bones inflame and ulcerate; the intervertebral substance wastes and disappears; the pressure of the superincumbent parts makes the superior adjoining vertebræ fall forward, or displaces them laterally, and produces distortion which is generally outwards. The compression on the spinal marrow and consequent paralysis increase, and the thoracic and abdominal viscera become affected in proportion to the distortion,—for, independently of the paralysis, the capacity of these cavities is diminished, and the contained viscera are pressed upon, and impeded in their functions. If the patient lives and the disease is situated high, the head falls forward as the distortion advances, the chin touches the sternum, and the chest is so diminished that the breathing becomes difficult. If the patient is a child, the upper parts of the body only increase in size, while the lower extremities seem to waste. When the disease is arrested and the cure effected, the use of the limb is gradually recovered, but the growth is still all towards the upper parts, the lower extremities continue small, and thus a distressing deformity is completely established.

From the history which has now been given, it appears that there are two well marked stages of this disease. In the first stage, the disease is entirely confined to the soft parts, and is the consequence of inflammation. It is indicated by weakness or paralysis of the lower extremities,

and some of the abdominal viscera, and by pain on pressure in the course of the spine. In the second stage, the disease has extended to the bones, which soon ulcerate; and when this has taken place, it is then characterised by complete paralysis, an evident bump or distortion, and by pain on pressure. There is never any bump or bony tumor till the disease is far advanced, and before this appears, the bone is either carious or the intervertebral substance is destroyed.

TREATMENT OF INFLAMMATION, CARIES, AND INCURVATION OF THE SPINE.

In the first stage of this disease, when the inflammation and its consequences are confined to the soft parts, there is neither bump, distortion, nor pain (except upon pressure) to indicate the seat of the complaint; but from the manner in which the patient is affected, from the paralysis of the lower limbs, and from the slow manner in which the inability has come on, we suspect an affection of the spine; and by a careful examination, we shall frequently be enabled to detect the seat of the complaint. This is not always the case, as the paralysis of the lower limbs has sometimes made a considerable progress, when there is no external mark nor even the least pain on pressure in the whole course of the spine. In order, if possible to discover the seat of the dis-

ease, the surgeon should carry his fingers slowly and firmly along the spinous processes of the vertebræ; and it will be often found that the patient will shrink and complain when the surgeon presses on the affected part. As it is of great consequence to discover the seat of the disease early, the surgeon should from time to time renew this examination, to find out if possible the inflamed part. When this cannot be done, and there is still reason to suspect the spine, the best practice seems to be to blister occasionally along its whole course, to alternate the blisters by frictions evening and morning with camphorated oil, volatile liniment, turpentine, and the other stimulant applications used in rheumatic and inflamed joints, and to confine the patient to the horizontal posture. In the course of the day he should recline upon a firm couch, and during the night sleep upon a firm mattress. If we are able to detect the seat of the disease, our [illegible] will be more efficient. In this case it will [illegible] visable to apply leeches and promote the [illegible] ing by warm fomentations. The leeches [illegible] be numerous and frequently renewed, a[illegible] intervals we have recourse to blistering [illegible] stimulating [illegible]s; but leeches, [illegible] mentation[illegible] [illegible]ctions, are trifling [illegible] when co[illegible] [illegible]h the caustic [illegible] early s[illegible] [illegible]stic issue exc[illegible] [illegible] the action [illegible] interna[illegible]

sides; and, in the advanced stage of the disease, when the bones are carious, it is the only efficient remedy except moxa and the actual cautery which operate in a similar manner.

In the second or advanced stage of the disease, in which the inflammation and its consequences have extended to the bones, and which, independently of the paralysis, is indicated by a bump, distortion, and pain in the seat of the disease, particularly on pressure, we have at once recourse to the caustic issue combined with rest in the horizontal posture, as far as the general health and other circumstances of the patient will permit. One issue should be inserted on each side of the bump in the spine, and an irritation kept up for some time by the introduction of peas besmeared with savine or blistering ointment, or with basilicon combined with red precipitate. After a time the irritation begins to abate, and when this is the case, instead of attempting to keep up a discharge, it will be better to withdraw the peas, allow the sore to heal, and then renew the caustic. This will be found to have more effect in curing the disease than keeping the issue open when the irritation is gone.

In all stages of this complaint, when the patient sits erect, walks, or takes exercise, the spine should be supported by some well contrived piece of machinery, such as Le Vacher's apparatus improved by Sheldrake and others.* Mr Pott con-

* Le Vacher was the first who recommended stays to sup-

demns without exception, all stays, springs, bandages, &c; but machinery must no doubt contribute most essentially to the cure, for if one or more of the vertebræ be diseased, their chance of recovery must surely be greater when relieved from the superincumbent weight; and this may be done by a well contrived pair of stays supporting the shoulders upon the pelvis, and taking off the pressure from the diseased bones.

In the cure of this disease, Mr. Pott first tried issues by incision, then setons, and at last issues by caustic. He attributes all to the discharge, saying, "It is a matter of little importance towards the cure, by what means the discharge be procured, provided it be large, that it come from a sufficient depth, and that it be continued for a sufficient length of time." Sir James Earle is of the same opinion, still ascribing all the benefit to the discharge; but if we carefully attend to the progress of the disease, and mark the effects of the caustic, we shall at once perceive

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port the superincumbent weight of the head and arms, and to keep the spine gently and permanently extended. Previous to his time, the spine was violently extended, by swinging the patient by the neck, by stretching the back by means of what was called the screw chair, or by forcing in the projection by a compressive machine. All these methods tortured the patient, farther inflamed the parts and increased the disease.

For the drawing and description of Le Vacher's machine, which, since his time, has been much improved, vid. Memoires de l'Academie Royale de Chirurgie Tome 10th. 12mo.

that this is contradicted by experience, and that they are entirely owing to the external irritation relieving the internal action. Hence, the larger the caustic, and the greater the irritation, the more manifest the advantage derived.

When we apply caustic in curvature of the spine, or in the disease of the hip joint, we perceive that the salutary effect is almost immediate, and long before the eschar separates, or the discharge is established. After the discharge has continued for some time, the disease becomes stationary, but the cure is again accelerated by the application of another caustic. It therefore appears, that it is in consequence of the irritation produced by the caustic issue, and not from the discharge, that a cure is effected. The caustic is for this reason preferable to the seton; the issue should be large and deep, and, instead of keeping up a discharge for any length of time by peas, the sore should be allowed to heal, and the caustics renewed again and again.

SECTION II.

ACCIDENTS OF THE SPINE.

It is from the vertebral column containing the spinal marrow, that we account for all the dismal consequences which arise from external injury.

To produce fracture or luxation, great violence is necessary, and these accidents are always followed by compression, the range of nervous energy being circumscribed in proportion to the height of the injured part. From the functions of the spinal marrow, and from the consequences which follow external injury, we are naturally led to compare its accidents with those of the brain itself. Hence, we find, that the paralysis which ensues may arise from fracture, from luxation, from the effusion of blood within its substance or sheath, and even from concussion.

Each division of the spine has its particular accidents. The neck is liable to luxation, but only by extreme violence,—as in violent twists, or in falls in hunting, and such occurrence in general immediately proves fatal; the vertebræ of the back are so fixed as to allow of little motion, consequently when they sustain a violent injury they are always fractured, but never luxated; and from the free and easy motions in the loins, the lumbar vertebræ are more easily and more frequently luxated than any other.

ACCIDENTS OF THE CERVICAL VERTEBRÆ.

The natural joints of the vertebræ are by no means strong as far as regards the bones. Their chief strength arises from their numerous and complicated ligaments; the oblique processes are

connected by a capsular ligament; there is an outward ligament down the whole fore part of the spine; there is a similar ligament within, running from the occipital hole to the bottom of the sacrum, connecting the bodies of the vertebræ; the bony arch is also held together by a posterior ligament; and, betwixt each two adjoining vertebræ, there is interposed the intervertebral substance. Besides these general ligaments, the two upper vertebræ of the neck are farther secured by particular ligaments. *1st*, They have no intervertebral substance betwixt them, but, independently of the capsular ligaments, the first vertebra of the neck is firmly secured in the whole of its circle by a ligamentous membrane, which ties it to the edge of the occipital hole. *2d*, From the anterior edge of the occipital hole, there is a perpendicular ligament which is implanted into the point of the tooth-like process of the dentatus tying it firmly to the occiput, and assisting in preventing the process from falling backwards upon the spinal marrow. *3d*, There are two lateral ligaments which arise from the sides of the odontoid process, and are implanted into the inner edge of the sides of the atlas, and of the occipital hole. These ligaments regulate the turning motions of the head, checking and preventing it being turned too far round. *4th*, The tooth-like process of the dentatus is farther secured in its place by a transverse ligament, which passes across the ring of the atlas

and firmly braces it down. All these ligaments are strong, and, from being short, their strength is greatly increased. They are connected with each other, and the structure of the joints is such, that all the nodding motions are performed by the head on the atlas, and all the rotatory motions by the atlas on the dentatus. When we reflect upon the smallness of the neck of the tooth-like process, the continual motion, the weight of the head, and the sudden violence that takes place in falls, it seems wonderful that this process so seldom yields; however it does sometimes yield, and when the perpendicular, transverse, and other ligaments are ruptured, the head falls forwards, the tooth-like process passes backwards, compresses the spinal marrow, and paralizes the lower parts of the body. I should conceive that this accident would always prove fatal,—because, whether the spinal marrow be compressed from luxation, or from fracture of the odontoid process of the dentatus, as the compression is above the origin of the phrenic nerves, the paralysis of the diaphragm which would immediately ensue, is sufficient to cause instant death.

So complete is the security given by the ligaments of the atlas and dentatus, that the older writers affirm there is no possibility of luxation. The attention of the profession was particularly called to this subject by Messrs. Petit and Louis, who, on the contrary, assert that this accident is frequent, and that few of those who are hanged

die of pure suffocation, but are first killed by luxation of the neck. Petit believes that the atlas is so immoveably fixed to the head, that luxation of it is impossible; but that the dentatus is frequently luxated from the atlas, as in those that are hanged; and that the lower vertebræ are still more frequently luxated, as they are operated upon by a longer lever. Parè, Heister, and Palfin, believe that there may be a luxation of the occiput from the atlas,—most other authors deny it,—and it seems to be admitted by the profession, as a principle, that the atlas and occiput are too firmly connected, and that the connection betwixt the atlas and dentatus, is too loose for the former to be luxated, or for the latter to escape. One of these joints has two motions, the other only one. There is a relative proportion betwixt the strength of the one and the weakness of the other; and it may be laid down as a fixed principle, that wherever there is a strong and a weak joint thus combined, the weak joint strengthens the strong one, as it will itself yield before the strong one can be hurt. We therefore conceive that the atlas is never separated from the occiput, because, before such a force could be applied as to effect it, the looser and weaker joint, which is the union of the atlas with the dentatus, would yield and be luxated.

The cervical vertebræ are seldom fractured. The accident that commonly happens to them is luxation; and it is apparent, that nothing but ex-

treme violence rupturing the ligaments will effect it. That great violence will luxate the neck and prove instantly fatal no one will deny,—the consequences of falls as in hunting, &c. are proofs of this; but that it occurs so frequently as is generally imagined, or that the patient ever recovers when the luxation is very high, I am far from believing. When the luxation is in the lower part of the neck, below the origin of the phrenic nerves, the patient continues to live for some time,—respiring with difficulty by the diaphragm; and if the pressure is soon removed from the spinal marrow by reduction, he may recover. Should such a case present itself, the surgeon must attempt the reduction by extension and counter extension. While one assistant forces down the shoulders, another should support the head by the occiput and chin, at the same time making a gradual extension. When the extension has been kept up for a little time, the surgeon with his thumbs, should attempt to push the projecting vertebra into its place. Should he be successful, the patient's head is to be properly supported by pillows; blood-letting, and the other antiphlogistic remedies are to be had recourse to; and an absolute state of rest must be enjoined.

ACCIDENTS OF THE DORSAL VERTEBRÆ.

In the back, the body of the vertebræ is long, and the intervertebral substance short, because there is little motion. The body of each vertebra is marked by the socket for the corresponding rib; the transverse processes are long, broad, and swelled out at the ends, and have another distinct socket for the second or little head of the rib; the spinous processes are conical, broad at their base where they come off from the vertebra, become gradually smaller towards their end, but terminate in a small tubercle or knot; and they are all so inclined downwards, that the one checks the other and no motion is allowed. The motion being checked by the overlapping of the spines, by the thinness of the intervertebral substance, and by the rib being fixed betwixt the two vertebræ to which it belongs, this part of the spine must serve as a steady fulcrum for the thorax to move on,—so that while it is the center on which the ribs move, it does not move itself. The limited motion of the back is marked by two very particular circumstances,—1*st*, The dorsal vertebræ are oftener anchylosed than any other part of the spine; 2*d*, In those, who by particular practice are brought to have a more free motion in their back, the bones assume a particular form by the spinous processes either projecting

straight out, or being prevented from growing to the proper length.

The vertebræ of the back, then, are so fixed, that there is little motion and no danger of luxation,—in fact, such an accident was never known. All the more violent injuries of the back, as falls or blows, instead of luxating the vertebræ must break them. Fractures of the vertebræ of the back are extremely frequent, and are always attended with paralysis of the lower parts of the body. At the moment of the injury, the patient becomes paralytic in all that is below the injured part; there is paralysis of the legs from compression of the sciatic nerve, or rather of the spinal marrow; of the urinary bladder, because it is supplied with nerves from the same source; of the rectum, as it has its energy from the same nerves; there is flatus and distension for want of regular discharges; and the patient lives in a most miserable condition,—paralytic in a way in which he can hope for no relief from art,—and obliged to have his urine drawn off with the catheter three times a day, whilst the rectum requires to be stimulated by occasional clysters. The lower extremities which have lost the full vigour of life, and their due proportion of that power which should preserve them, in the couse of a few months fall into gangrene, and the patient sinks and dies. Conjoined with these symptoms there is also a curious circumstance

which attends fractures of the spine,—I mean a constant erection of the penis.

We have already observed, that it is from the office of the vertebral column transmitting the spinal marrow, that all the dangerous consequences ensue, for otherwise the vertebræ would throw out callus and be reunited like other bones; but, in fracture, there is an immediate pressure and palsy, and it appears, that when the patient lives, as he sometimes does in this unhappy state, the reunion of the bone, while displaced, the exuberance of callus, or some other cause, continues to compress the nerves, and the palsy is never cured.

Pressure and shocks are more dangerous to all parts of the nervous system then wounds. We find people frequently recovering from wounds of the brain, while, on the contrary, we often see them dying of mere concussion, and very often from compression. A fall upon the spine, on the loins for instance, even without fracture or luxation, will produce palsy, which blisters will relieve; but, whenever the spine is fractured, an incurable palsy ensues. When fractured high in the neck, there is universal palsy and death, because the vital nerves, as those of the heart, lungs, diaphragm, &c. come off below; in the back there is the same universal palsy of all the parts below; and when in the loins, there is palsy both of the lower extremities and the contents of the pelvis.

Fractures of the spine, especially of the bodies of the vertebræ, are not very easily distinguished. The whole tract of the spine lies very deep; the spinous process only can be felt; by pressing on them, we can distinguish the part that is hurt, perhaps by a crepitation; in touching one spinous process, we can feel that it is fractured; or, by the spinous process of one vertebræ being particularly sunk, we can ascertain that the fracture is there. We judge that there is fracture, by the nature of the violence, by the pain, by the feeling of softness; and if there are crepitation and yielding of the broken pieces, with an emphysematous tumour, we are sure of it. We often judge of the presence of fracture by the paralysis below, although it must be remembered that this is no characteristic mark, for there may be paralysis from mere concussion.

From comparing fractures of the spine with depressions of the cranium, similar operations have been proposed. We are directed by some writers to make incisions, in order to raise the depressed bone, or to remove splinters which push inwards upon the spinal marrow. Others talk of extension and counter-extension, which is equally wrong,—all manual operations being not only useless but dangerous. All that we can do, is to lay the patient in the most easy posture in bed, and avert inflammation by local blood-letting, and by the other antiphlogistic means. The palsy of the lower extremities is incurable, and,

therefore, it is useless to torment the patient with blisters, issues, &c. The detrusor urinæ is paralytic, and the catheter must in consequence be occasionally introduced. The rectum is torpid, and must be moved daily by stimulating glysters. The patient often falls low, and, at the end of six weeks or two months, is attacked with convulsions and delirium and dies. Sometimes he lives many months or years in a deplorable condition,—the upper parts of the body being tolerably nourished, and the faculties entire, but all below the middle of the body remaining dead. If the compression be great, he has first suppression of urine from paralysis of the bladder, and then stillicidium or an involuntary evacuation from palsy attacking the sphincter also. The sphincter ani likewise becomes paralyzed, the fœces are involuntarily discharged, and this paralysis of the sphincters and unconscious evacuations of fœces and urine are marks of approaching death. The yielding of the paralyzed sphincters to the pressure of the abdominal muscles, is the cause of the evacuations; and it frequently happens, that when this paralysis has existed for some time, several parts of the lower extremities are attacked with spots of gangrene, and thus the patient dies a miserable death.

ACCIDENTS OF THE LUMBAR VERTEBRÆ.

The lumbar vertebræ are peculiar in largeness and strength. Their bodies are large and broad, supporting the whole weight of the trunk; their articulating processes are perpendicular and not oblique; their transverse processes are strong, large, and direct; and their spines are not forked, like those of the neck, nor aquiline and overlapping like those of the back, but flat, ending in large knobs, and standing directly out from the body of the vertebræ. From the peculiarities of their structure, they are evidently intended for free and easy motion; and to render this at once unconstrained and safe, there is interposed betwixt their bodies an inter-vertebral substance almost as thick as the body itself; and their spinous and transverse processes stand out free of each other, while their articulating processes are long and perpendicular, to secure the joint.

From the thickness of the inter-vertebral substance, the straightness of the processes, the distance betwixt bone and bone, and the very free motions of this part of the spine, it is evident that the lumber vertebræ must be more subject to luxation than fracture. In certain positions, as when erect, the perpendicular bearing of the body and processes of the vertebra prevents the

possibility of luxation; but, in the bended trunk the inter-vertebral substance is compressed, the spinous processes rise and depart from each other, the one articulating process moves along the smooth face of the opposite one, till the tips of each stand opposite touching each other, as the teeth of the upper and lower jaws touch, and are thus ready to be displaced by the slightest force. Nothing now holds them but the ligaments, which are, in this position, on their utmost stretch; and any blow upon the back, such as bursts these ligaments, will luxate the loins. Thus, a man stooping in the hold of a ship, or bending to lift a heavy weight, while something falls upon him, is very apt to experience this accident; or, perhaps the effects of posture combined with a blow upon the loins, may be still better illustrated by conceiving what might happen to a man while passing in a cart under an arch. He stoops all that he is able, but not enough to escape the arch; and, while he is in this bent posture, the inter-vertebral substance is compressed before, the spinous processes are raised to the utmost, the back ligaments are stretched almost to yielding, and the tips of the articulating processes are opposed to each other. If in this situation, he is pressed betwixt the arch and the cart, there would follow a complete luxation; but if the person, to avoid the danger, at the same instant bended and twisted sideways, the one vertebra

being depressed and the other raised, a lateral luxation would be produced.

The bent posture of the body, and incapacity of raising it, the pain and sense of rupture among the ligaments at the time of the fall or blow, the difficulty of walking or supporting the weight of the body, paralysis of all the parts below the seat of the injury, inability to pass the urine or fœces, inflation of the bowels, coldness along with palsy of the extremities, and at last gangrenes are the symptoms which characterize this luxation; and although the luxation be reduced, still the patient may die, as Petit remarks, by the continuance of the paralysis, and the occurrence of gangrene, in consequence of the inflammation and thickening of the parts in the seat of the injury. In complete luxation, the body is bent directly forwards, with great pain from the deranged state of the joint, and the muscles of the back are on the stretch. In lateral luxation, the body is turned to the opposite side, and at once bended and distorted.

The older surgeons, in attempting to reduce luxations of the loins, always bent the body backwards, which must have fixed the luxation, and not only rendered it more irreducible, but also compressed and hurt the parts. They hung up the patient by the armpits, made a feeble extension by lacs and towels, which were fastened upon the shoulders and haunches, and they then applied a forcible compression upon the dislocated

bone, by means of hard compresses of wood laid upon the sides of the displaced vertebræ. These faulty methods were first pointed out by Petit. The true and most simple method to reduce a luxated vertebra, is to bend the patient forwards over a barrel or other large cylindrical body. As the body is inclined forwards, the spinous processes are farther separated from one another, and the articulating processes more disengaged. After the patient has been bent as far forwards as can readily be effected,—he should be suddenly raised, when the displaced bone will most likely start into its place; but should the trial fail, it must be repeated again and again, and the reduction will be greatly assisted by the surgeon pressing steadily and firmly with his thumbs upon the vertebra, immediately below the dislocated one. This will free its superior articulating processes from the lower ones of the displaced bone, and allow it more easily to regain its natural position. I need hardly remark, that after an accident of this nature, as well indeed as after all other accidents of the spine, the patient should be long confined to one posture; while from the first, we have recourse to the strictest antiphlogistic regimen.

CHAP. X.

ACCIDENTS OF THE TENDONS.

GENERAL REMARKS ON THE STRUCTURE OF THE TENDONS.

As inflammation precedes a change of structure in every texture of the animal body, those textures which are most prone to inflammation must be the most liable to disease. The predisposition of an organ to inflammation is in proportion to its vascularity and sensibility; and as the tendons possess no sensibility, and little vascularity, they do not easily inflame,—they are consequently seldom diseased.

The older surgeons believed that wounds of the tendons were followed by the most frightful train of symptoms, and this doctrine was universally maintained till the time of Haller and Dr. Hunter. It is not above fifty years since the sensibility of tendons began to be questioned, and in a very short time the truth was fully ascertained.

1*st*, Haller and his pupils instituted a long course of experiments to determine this point. They laid the tendons bare,—poured sulphuric acid upon them,—applied caustics to them,—burnt them with hot irons,—and transfixed them with needles and scissars,—yet the animals upon whom these experiments were made, never exhibited the slightest sense of pain. They took a little dog, transfixed its Achilles tendons with embowelling needles,—and allowed them to remain,—still it played about the room leaping upon the chairs and tables. *2d*, Mr Feron of Montpellier dropped strong sulphuric acid upon the peronæi tendons, of a patient who was under his care with a wound which exposed these tendons. He pricked them, touched them with caustics, and made them slough, and he repeated his experiments, but without any signs of pain. *3d*, Mr Teckel had a patient, a labouring man, who, by some accident in loading a cart, cut off the ends of the middle and ring fingers, the latter in such a manner, that about half an inch of the tendon of the perforans projected, and in this condition he saw him about ten minutes after the accident. It was about the time that Haller and Dr. Hunter began to doubt of the sensibility of tendons, or rather to deny that they possessed any sensibility. Mr Teckel was therefore determined to put their opinion to the test of experiment. "He passed a piece of string about the size of the tendon, round the man's wrist, from thence he

brought it about the injured finger, and placed it in such a manner, as to make it project parallel to and beyond the stump, of equal length with the exposed tendon. He then told his patient that he intended to cut the one or the other of these projecting parts, with his scissars, while he should turn his head away, but he was to tell him which he cut without seeing what was done. The man laughed, and asked him whether he thought he had no feeling? however he complied. He then divided the tendon with his scissars; he was asked which he had cut? he answered, "the string;" but when he turned his head round, and found it was actually the tendon, he was much surprised that he had felt no pain, and when he talked to him afterwards, he declared he felt not the least pain, and absolutely thought he had cut the string only." *4th*, As another proof of the insensibility of tendons, we see in rupture of the tendon of the patella, and tendo Achillis, that, as far as the tendon is concerned, there is no pain; and that no harm follows surgical incisions through tendinous aponeurosis. Besides the proofs which have now been adduced of the insensibility of tendons, the doctrine of the older surgeons involved a manifest absurdity, they being in the continual practice of sewing wounded tendons, so that they every day saw the largest tendons cut and ruptured, and sewed and healed, without any sense of pain, or without the operation being followed by any bad symptom. The

tendons, then, stand so low in the scale of feeling, that when, like the ligaments, they become the subject of the surgeon's management, it is more under the form of accident than disease.

ACCIDENTS OF THE TENDONS.

The tendons are chiefly exposed to wounds and ruptures, and all the tendons of the body may be so injured; but there are two tendons which are so particularly liable to be torn, that their rupture frequently falls under the management of the surgeon. These are the tendinous ligament of the patella, and the tendo achillis.

RUPTURE OF THE TENDINOUS LIGAMENT OF THE PATELLA.

The ligament of the patella is often ruptured. This accident is by many, and particularly the older writers, called luxation of the patella upwards. It occurs in consequence of the forcible action of the extensor muscles of the leg, which are implanted into the patella. The patient becomes instantly lame; the patella is retracted upwards, and the joint is thus uncovered; the bone is felt above the joint quite moveable; there is a depression in the natural situation of the bone, into which the fingers can be pushed; and the patient cannot ex-

tend the leg. There generally succeeds considerable swelling, which frequently for a time prevents the surgeon from ascertaining the real nature of the injury, and which might lead him to confound it with fracture of the patella; but it is a much more curable accident, and less liable to disorder the joint.

In the treatment, we extend the leg, laying the limb upon a board and placing the patient in bed in a half reclined posture to relax the extensor muscles; we wait for a few days till the inflammation and swelling subside, which may be promoted by the application of leeches and saturnine lotions; and after the abatement of these symptoms, we bring down the patella by pressing the hands along the fore part of the thigh, and fix it in its place by passing a roller bandage round the body and carrying it along the whole thigh. The ligament soon regains its adhesion, and the patient is cured without lameness.

RUPTURE OF THE TENDO ACHILLIS.

In consequence of the violent action of the gastrocnemii muscles, as in dancing, leaping, and other exertions, the tendo achillis is not unfrequently ruptured. From its exposed situation, it is also sometimes cut across. When ruptured, the patient is immediately sensible of the nature of the injury; he hears a loud crack, and at the

same time feels as if he were smartly struck in the part with a whip or switch; he cannot stand, but either falls down or supports himself with difficulty; and he can neither walk nor extend the foot with the same power as formerly, but there is little or no pain at the time of the accident. The bellies of the gastrocnemii muscles are immediately retracted, drawing back the upper and attached portion of the tendon, and leaving a hollow into which two or more fingers can be inserted. This vacancy can be more distinctly perceived when the foot is bent, as the ruptured extremities of the tendon are then farther separated from each other.

The treatment of the injured tendo achillis, whether ruptured or cut, is extremely simple; and both cases are to be treated in the same manner. The accident can be more simply managed by posture and bandage than by the slippers of Petit or Monro, and with equal effect. These contrivances are therefore now seldom used; all that is requisite is to lay the limb on its outside, to extend the foot and keep it in the extended position. This makes that portion of the tendon which is attached to the os calcis, approximate that which is connected with the muscles. The knee is then to be bent in order to relax the gastrocnemii muscles, and the surgeon now desires an assistant to bring down the muscles with his hand, so as to place the ruptured extremities of the tendon in contact, which is always easily

done. He now applies a roller to the limb, commencing above the knee and carrying it along the leg with a moderate degree of firmness; but taking care to terminate a little way above the seat of the injury. If the bandage be carried down to the foot, the tendon will be compressed, and will therefore adhere to the neighbouring parts, and, when it heals, its mobility will be in a great measure lost. To obviate this consequence, it has been proposed to apply two small bolsters or compresses, one on each side of the tendon; but, it appears to me, to be preferable not to carry the roller over the seat of the injury. By leaving the tendon uncovered, the surgeon can examine, from time to time, the state of the parts, and the bandage so applied is perfectly effectual. Although position would completely place the ruptured extremities of the tendon in contact, it is necessary to apply a bandage,—as the roller not only keeps down the upper portion of the tendon, but by its pressure, prevents the tendency in the muscles to contract.

Notwithstanding the little vascularity in the tendons, if the limb is placed and secured in the position now directed, the tendo achillis heals very readily, and the patient recovers without the smallest lameness.

CHAP. XI.

DISEASES AND ACCIDENTS OF THE BLOOD-VESSELS.

GENERAL REMARKS ON THE STRUCTURE OF THE BLOOD-VESSELS.

The arteries and the veins differ in many respects from each other. The arteries are strong, flexible, muscular tubes, which convey the blood from the heart over all the parts of the body. The veins are in greater number than the arteries; they are thin in their coats, and want the contractile power of the arteries; they bring back the blood from the remote parts of the system, and deposit it at the right side of the heart. The arteries have no valves except at their commencement at the heart, whereas, the veins are plentifully supplied with them, more especially in the extremities. The arteries increase in number and decrease in size as they recede from the heart; and the veins decrease in num-

ber, and increase in size as they approach it. The arteries are white, in the dead body they are always found empty, and, in consequence of their elasticity, they preserve their cylindrical form; but the veins are purple, and are always found full of blood after death. The veins want the firm muscular covering, which is the principal coat of the arteries; and we cannot discover in them those transverse muscular fibres, which are so conspicuous in the arteries; but in the vena cava near the heart, the muscular coat is very distinct, and this vessel evidently contracts so as to drive the blood onwards towards the heart.

The veins, as being continually seen upon the surface, and being often bled, were much studied by the ancients. They were considered as the chief causes of disease, and were often named according to their connections, as cephalic, salvatella, &c.; but the Harveian doctrine turning our whole attention to the more active part of the system of blood-vessels, the arteries have been particularly studied, and the veins almost neglected. The arteries have all the chief functions of the system to perform; they circulate the blood,—they secrete all the humors, except the bile, which is the only secretion from venous blood,—they nourish the body by a universal secretion,—and they have various degrees or modifications of action in each part; while the veins are destined only to gather up the blood after these various offices have been performed, and return it to the heart. Upon its

arrival there, it is propelled into the lungs, where its properties are renewed before it again passes onwards to those active vessels, by which it is applied to the wants of the system.

The arteries have three coats, an external, a middle, and an internal coat. The external coat is composed of condensed cellular substance. The common cellular membrane, as it approaches the artery, becomes more delicate, is free of fat, and attaches itself by a sort of network of small and delicate threads to the outer surface of the artery, so as to constitute its external coat. The external coat is easily unravelled into cellular substance, consisting of successive layers, proportioned in thickness to the size of the artery, and growing thicker when the vessel becomes diseased. It is in this coat that the strength and elasticity of the artery chiefly reside, and it bears a much greater proportion to the muscular coat in the larger than in the smaller arteries,—hence the larger arteries are the most elastic, and the smaller ones the most muscular. It is this cellular or external coat which conveys the arteriæ arteriarum, or vessels which nourish the muscular and internal coats, and which do not arise from the arteries which they supply, but from the neighbouring trunks. This coat defends the artery, and connects it so with the adjacent parts, that as they move the artery moves without violence or danger.

The muscular coat is the second or middle coat

of the artery; it is of great strength, consists of circular fibres, and forms the chief thickness of its walls. It is by the action of this coat seconding the stroke of the heart, that the blood is worked throughout the whole arterial system.

The internal coat is so delicate and so closely connected with the muscular, that in a sound and healthy artery it cannot be seen, or at least very easily distinguished. It is thin, white, and of the appearance of membrane, yet possessing more elasticity and strength than its appearance would indicate. It is best seen when by putrefaction, or long maceration, it begins to separate from the outward coats, and, it is then perceived to be vascular, to have many arteries and veins upon a surface, which looked at first sight to be too smooth and cuticular, to be vascular in any great degree. This coat, in its structure, is analogous to the pleura, peritoneum, and other serous membranes, —hence it is sometimes called the serous coat. It is the coat the most easily inflamed, and the adhesion of which in its opposite surfaces, secures those arteries which the surgeon needs to tie in aneurisms and wounds. It is the degeneration of this inner coat, that makes a great part of that change which the arterial system undergoes at the approach of old age, and which prevents the success of operations, the issue of which is so certain in the young and healthy subject. It is upon this inner coat, too, that those spots of ossification appear, which constitute the beginning and original cause

of one of the most dreadful and fatal diseases. These spots of ossification, not only weaken the walls of the artery, and render its inner coat liable to rupture, but also in a peculiar manner weaken its action,—because the internal coat is very intimately connected with the muscular coat by a cellular substance. Except in youth, and in the smaller arteries, this coat is peculiarly apt to tear, and, when in old age, it begins to assume a thick consistence, and become of a yellow colour, it is just beginning to ossify in spots, after which it soon falls into total disease. At this time it is easily torn with the nail, or, in a farther stage of this affection, it may be bruised betwixt the fingers nearly to powder. This coat, by its closeness of texture, contains the fluids; while the vessel works upon them, it does not permit the most minute particle to pass through in the way of transudation; and its smooth and slippery surface makes them glide easily along.

Of these three coats, the muscular and inner coat are the weakest, and they are capable of sustaining little injury; if a ligature is applied round the artery, and pulled with any degree of force, the middle and internal coats are invariably cut, while the external coat remains unhurt; or, if an artery is forcibly distended by injection, the same occurrence takes place.

The texture of the veins cannot be so completely unravelled into distinct coats as the arteries, but, like them, they have three coats. The

external or cellular coat is very thin and loose in its texture, and very closely connected with the inner coats: no muscular fibres can be distinctly traced in the middle coat, except in the cavas; and the internal coat is a serous membrane, much more distensile and much more susceptible of inflammation than the inner coat of the arteries. This susceptibility to inflame, is evinced in the inflammation of hemorrhoids,—in the quickness with which a wounded vein adheres, when its sides are laid together,—in the extensive and even fatal inflammation, which frequently follows the application of a ligature,—and in the inflammation of the vein which sometimes happens in venæ-section. The veins have more frequent anastomoses than the arteries; from the want of muscular fibres they are capable of greater dilatation without rupture of any of their coats, when the dilating power is slowly applied; but, when suddenly injured, they tear more readily,—and hence the deep seated veins of the lower extremity frequently give way under the action of the muscles. Though the veins possess little elasticity, they are capable of changing their calibre in a marked degree according to the difference of temperature; and when they dilate and become varicose, their coats, like those of the arteries, always become thicker.

SECTION I.

DISEASES OF THE ARTERIES.

INDEPENDENTLY of various morbid alterations which have been occasionally observed in the coats of arteries, they are, like other structures of the human body, subject to inflammation, and the effects of this inflammation are deducible from their structure. Being composed of serous membrane, muscular fibres, and cellular substance, the inflammation generally terminates in adhesion, ulceration, or gangrene. Suppuration is a rare termination, and schirrus is unknown. The inflammation may be confined entirely to the artery, or it may be attacked in common with the surrounding parts. When confined to the artery, the inflammation is generally the consequence of wounds or ligatures; if the action be moderate, it terminates in an effusion of coagulating lymph into the cavity of the artery, and consequent adhesion of its opposite sides; and if the irritation is too great for adhesion, it terminates in ulceration. In cancerous and other malignant ulcers, the coats of the arteries are involved in the ulceration. If this is rapid, and more especially where the artery is large, a troublesome or fatal hemorrhagy frequently succeeds;—again, if the

ulceration is slow, and the vessel of the smaller order of arteries, the ulceration is preceded by the adhesive inflammation, which shuts up the artery for some space, and secures the patient against hemorrhage. When extensive inflammation terminates in gangrene, the arteries are involved with the neighbouring structure, but, upon the separation of the mortified parts, no hemorrhage succeeds. This arises from the same inflammation, which, by an excess of action, terminates in the death of one part, having terminanated in the vessels leading to it, where the action is more moderate, in adhesion, and thus effectually closed them,—as is more particularly explained in Volume 1st, under the head of Mortification.

Various morbid appearances in the structure of the arteries have been related by medical writers, but the most frequent are ossification and a deposition of atheromatous or pultaceous matter betwixt their coats. Ossification, or rather a deposition of calcareous matter, is peculiarly frequent in the decline of life, particularly in the aorta and larger arteries. It occurs more rarely in early life. It seems to be peculiar to the internal coat, and is generally deposited in specks along its external surface. This morbid change so far alters the structure, that the artery does not adhere, but ulcerates when a ligature is applied. The action of the vessel is weakened, and the internal coat becomes now so friable as to

crack upon any violent or sudden exertion. This change of structure and consequent rupture, is the most frequent cause of spontaneous aneurism*.

The accumulation of a purulent, or rather pultaceous matter betwixt the muscular and inner coats of an artery, is also a very frequent occurrence, and sometimes prevails to such a degree as to obliterate the cavity of the vessel; at other times it leads to ulceration of the inner and middle coats and the formation of aneurism. In this state of the arteries, there is generally a deposition of calcareous matter, with considerable thickening of their coats.

The whole pathology of the arteries is particularly interesting, but the disease which falls more immediately under the care of the surgeon, and which we now proceed to consider, is aneurism.†

ANEURISM.

An aneurism may be defined, a pulsating tumor beating synchronously with the arteries, and con-

* It is a remarkable circumstance, that out of twenty-two dissections of maniacal patients, recorded by Dr Marshall, ten should have had the arteries of the brain ossified, or otherwise diseased.—Vid. Marshall on Mania and Hydrophobia.

† For a more detailed account of morbid changes in the coats of arteries, see Morgagni, Haller, Scarpa, and other writers; but more particularly Hodgson on the diseases of the ar-

taining arterial blood, which is in general partly fluid, and partly coagulated, although sometimes altogether fluid, and which is for the most part out of the course of the general circulation. This definition, I apprehend, will be found to embrace every species of the disease.

Systematic writers have enumerated and described four kinds of aneurism; *1st*, True aneurism.—*2d*, False aneurism.—*3d*, Varicose aneurism; and *4th*, Aneurism from anastomosis. *1st*, True aneurism arises from the rupture or ulceration of the internal and middle coats of a diseased artery, in consequence of which, the external or cellular coat becomes dilated, forming a beating tumor. *2d*, False aneurism occurs when all the coats of an artery are ruptured or cut; the blood escapes from the vessel and is always effused under the fascia; the surrounding cellular substance is condensed by adhesive inflammation, and thus a pulsating tumor is formed. *3d*, Varicose aneurism arises from the blood of an artery passing into a vein and dilating its coats. When an artery has been wounded through a subcutaneous vein, as in bloodletting, it sometimes happens that the wound in the skin, and in the anterior part of the vein, heals; while the wound in the posterior part of the vein in the fascia, and in the anterior part of the artery still remains open. A communication

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teries and veins, a work containing many valuable pathological views of the vascular system.

is thus kept up betwixt the artery and vein, in consequence of which the vein becomes dilated, and forms an oblong tumor, which is more or less large, not according to the duration of the disease, but according to the size of the opening betwixt the artery and vein. *4th*, Aneurism from anastomosis is a bluish or purple tumor, of a sacculated or cellular structure, containing arterial blood effused from communicating arteries, and having a distinct pulsation, which is particularly conspicuous when these arteries are excited to increased action.

1st. TRUE ANEURISM.

I have described this form of the disease, as depending upon a rupture of the internal and middle coats, and a dilatation of the external coat of an artery; but Fernelius, and other physicians of his time, ascribed the disease to a dilatation of all the coats. Hildanus and Senertus first believed that there was a rupture of the proper coats: this was denied by succeeding writers, and it was long a contested point, whether true aneurism arose from a dilatation or a rupture of the proper coats of the artery. Although there are many accurate dissections on record, accompanied with drawings, pointing out the rupture of the proper or external and middle coats of the artery, with the hole opening into the aneurismal sac or

dilated cellular coat, Haller describes all the coats as uniformerly dilated, and surgeons universally assented to this opinion, till Scarpa again pointed out the true nature of the disease. He remarks that the internal and muscular coats, or what are called the proper coats of the artery, are always ruptured, and that it is therefore only the external or cellular coat which is dilated into the aneurismal bag. Scarpa founds his observations on the surest grounds, dissection. He observes, that there is always a "corrosion or rupture of the proper coats of the artery, and that the blood is consequently effused under the cellular sheath, or any other membrane which covers externally the injured artery*." He farther observes, "that when an artery is dilated, the dilatation involves the whole circumference of the artery, while the root of an aneurism only occupies one side, and never the whole circumference of the tube,—hence, in aortic, popliteal, and the other species of true aneurism, the tuberosity or tumor always arises from, and is situated on one side of the artery, and the passage from the artery into the tumor, is always small when compared with the size of

* Scarpa evidently confounds the cellular sheath with the cellular coat of the artery. Independently of the cellular sheath into which an artery readily retracts when divided, it is furnished with an external or cellular coat, which, when the proper coats are ruptured, must form the aneurismal sac, at least in the first instance.

the aneurismal sac.—The tumor has a narrow neck, while it becomes larger as it distends or recedes from the artery, and when carefully opened on the side opposite to the aneurismal tumor, the opening betwixt the tumor and the artery can be distinctly seen, small like the opening of a fistula, and sometimes with fringed-like, or lacerated edges,—therefore, when a true internal aneurism bursts, two distinct openings are perceived upon dissection, one in the proper coats leading from the artery into the tumor, and one in the aneurismal sac through which the blood has escaped into the thorax or abdomen."

Although Scarpa describes the aneurismal tumor as always situated on one side, and never involving the whole circumference of the artery, cases, no doubt, do occasionally present themselves, where the tumor is equally prominent on all sides. An instance of this kind lately occurred in the Royal Infirmary of this city. It was a popliteal aneurism of eighteen months standing. The tumor, which involved the whole circumference of the artery, was of the size of the fist, and of an oval form, filling the whole cup of the ham, and extending downwards under the head of the gastrocnemii muscles. Upon careful dissection of the aneurismal tumor, I found that the internal coats of the artery were lacerated in their whole circle, that upon the inner coat close upon the laceration, there was a hard yellow speck the size of a pea, and that the tumor was formed

entirely by the dilatation of the external coat of the artery. There appear, therefore, to be two forms of the disease; 1*st*, One in which the internal coats are partially lacerated, and the tumor is then formed upon one side of the artery,—in which case there is always a distinct hole leading into the aneurismal sac, and the blood which passes through it is removed from the channel of the artery, so that lamellated coagula are formed; —and 2*d*, Another in which the internal coats are ruptured in the whole circle, the tumor, in this case, involving the whole circumference of the artery, and in which the blood is not out of the common course of the circulation, notwithstanding which, there is still a deposition of lamellated coagula, because, in the seat of the aneurism, the artery is so weakened that it cannot propel the whole of its contents like the rest of the tube.

That true aneurism is always formed by the rupture of the proper coats, and dilatation of the cellular coat of the artery, is the opinion of the generality of surgeons of the present day. The dissections in which I have been engaged, and all the preparations which I have seen, tend to support this doctrine, I therefore cannot help assenting to it, although Messrs. Boyer, Charles Bell, and some other surgeons of eminence, still maintain, that true aneurism frequently depends upon a dilatation of all the arterial coats.

In the formation of this species of aneurism, the internal coat of the artery is always diseased,

before it ruptures or ulcerates. A healthy artery would not ulcerate, and the laceration of its internal coats would cause an effusion of coagulating lymph, and lead to the obliteration of its cavity and not to aneurism, as is exemplified by the application of a ligature. It therefore appears, that the artery is always diseased previous to the commencement of true aneurism. In some cases there seems to be a general affection of the arterial system, as there frequently occur two or three aneurismal tumors in the same limb, and in the course of the same artery, or in different parts of the same body at one time. Thus it is by no means an uncommon case, for a patient to labour both under a popliteal and an inguinal aneurism in the same limb at one time, or to have an aneurism in the subclavian artery, and another in the ham, together; and I have known a patient, who, after having been operated upon for femoral aneurism, and recovering so completely as to return to his usual avocations, died three years after, by the bursting of an aneurism of the abdominal aorta. The laceration of the internal coats of the artery and the origin of the disease can be so frequently traced to some sudden exertion, that, in nine cases out of ten, true or spontaneous aneurism, as it has been called, is as much the effect of an accident as a luxated joint or a fractured limb. The coats are generally ruptured transversely, but sometimes longitudinally; and the

rupture is sometimes small, sometimes extensive, but always apparent.

In the progress of the disease, from its commencement till the period of its final termination, there is a succession of stages which can be distinctly traced. As soon as the proper coats of the artery ulcerate, or are ruptured, the blood comes in immediate contact with the cellular coat, which is dilated into the aneurismal tumor. The blood being now out of the course of the circulation, its coagulating lymph is deposited in successive layers, which, for a time, assist in resisting the action of the heart and which, from the manner of their formation, are always firmer the farther they are removed from the channel of the artery. The cellular coat dilates slowly, and when it is no longer capable of supporting the distention, it yields. The blood is now farther resisted by the sheath of the artery, which at this time forms the walls of the aneurism; but the sheath in its turn gives way, and the blood then comes in contact with the adjoining soft parts; still it does not become diffused, because these parts are all firmly consolidated into a sac by coagulating lymph, which is effused in consequence of the inflammation excited by the distention of the aneurismal tumor. As the tumor distends, its walls do not become thinner, but actually thicker, from the addition of condensed cellular substance. The patient frequently dies before the aneurism bursts, but when this is not the case, it

has been remarked, that on the surface of the body, and in hollow passages lined by mucous membrane, the aneurism yields by inflammation terminating in grangrene; whereas, in those cavities lined by serous membrane, it gives way by laceration*.

The most common seats of true aneurism, are the thoracic aorta, especially in its arch; the abdominal aorta, particularly where it gives off the cœliac artery; the popliteal artery, and the carotid artery, at its division into the external and internal branches. The next most common positions of the disease are the iliac, the femoral, the subclavian, and the axillary arteries. It appears rarely in the larger arteries of the upper extremity, and never in the smaller order of arteries any where.

2d. FALSE ANEURISM.

We have defined false aneurism, a pulsating tumor caused by the escape of the blood from an artery into the surrounding cellular substance, in consequence of all its coats being ruptured or cut. Although writers differ with regard to the precise nature of true aneurism, whether it depends upon a rupture of the proper coats and a

* See an able and valuable treatise on the diseases of the arteries and veins by Joseph Hodgson.

dilatation of the external coat of an artery, or is merely a dilatation of all the coats, or sometimes of both, they are all agreed with regard to the state of the artery in false aneurism. To constitute this disease, the blood escapes entirely from the channel of the artery. This aneurism may be either circumscribed or diffused, as the artery is covered and surrounded with a denser or weaker fascia, or with a firmer or looser cellular substance. Thus, when the artery is wounded in the upper part of the arm, or the lower part of the thigh, from the looseness of the cellular substance and fascia the blood easily escapes, extending upwards and downwards, and the aneurism becomes diffused; while at the bend of the arm, and in the upper part of the thigh, the artery is covered and bound down by a very thick and strong fascia, the blood escapes from the artery with difficulty, the tumor is slowly formed, and the aneurism is circumscribed. It therefore appears, that the terms circumscribed and diffused aneurisms are useless distinctions, as both states of the disease depend upon the same circumstance, namely a wound in the artery, by which the blood is effused under the fascia which covers it. From this statement it is evident, that an aneurism may be circumscribed at first and remain so for a considerable time, but at length become diffused in consequence of a blow or some violent exertion.

The species of the disease now under consi-

deration, may occur from the rupture of an artery by some sudden exertion; but it most frequently happens in consequence of the artery being wounded by a sharp-pointed instrument, as a penknife, sword, or pair of scissars. It most frequently arises from the median basilic vein being transfixed in the operation of phlebotomy, and hence false aneurism most commonly presents itself in the brachial artery at the bend of the arm.

When an artery is opened, a profuse bleeding of a bright vermilion colour succeeds; the blood is thrown out in jerks, with considerable force; and the hemorrhagy is very difficult to repress. When the hemorrhagy is repressed by pressure, and the limb is bound up, the lips of the external wound immediately adhere, while the wound in the artery either remains open, or is stopped for the time by a clot of blood. The clot is forced out upon the slightest exertion, the blood then escapes from the artery into the surrounding cellular substance under the fascia, and in a short time a small tumor is formed. This is at first, soft and circumscribed, and has a distinct pulsation, and the blood can by pressure be returned into the channel of the artery. Hence pulsation and retrocession of the blood, when the tumor is pressed upon, have been esteemed the chief characteristic marks of aneurism.

The return of the blood into the channel of the artery by pressure, was a mark much insisted upon by the older surgeons; and, by modern wri-

ters, this is still esteemed characteristic of the disease. But retrocession of the blood, when pressed upon, more properly belongs to true aneurism than to this species of the disease. In the early stage, the blood can no doubt be returned by pressure, and the tumor can be made to disappear; but, whenever the tumor is of any magnitude, and has become hard, in fact, almost always before the patient applies for surgical assistance, this criterion is lost. The blood is out of the course of the circulation, it is coagulated and involved in cellular substance, and cannot be returned into the artery. The pulsation of the tumor stands nearly on the same footing with the retrocession of the blood when pressed upon, but is rather a more certain sign. It is always in some degree perceptible, although, in progress of the disease, it becomes gradually less evident. The pulsation is very distinct in the commencement of the disease, and while the tumor is small, but it gradually becomes weaker as the tumor increases in size; and at last the effused blood is so coagulated, and so firmly impacted in the cellular substance, that the beating of the artery can effect it but little. The pulsation at this time has almost disappeared, and the tumor is so hard as not to yield to the pressure of the fingers, and is affected by the arterial stroke, in a much less degree than any common tumor situated above a large artery. It is even less affected than any unconnected tumor would be, as it is firmly

bound down by the general fascia under which the aneurism is always formed. There are many cases on record, particularly in the writings of Vesalius, Lancisi, De Haen, Ruych, and Warner, where aneurisms mistaken, from the want of pulsation, for common abscesses, have been opened, and the patients have died of hemorrhage. Retrocession of the blood when pressed upon, and pulsation, are therefore not the true tests of the disease. It is also necessary to take into account the history of the case, with the existence of other symptoms.

Weakness or cessation of the pulse, with coldness, numbness, and diffused pain of the limb, are, in fact, the true circumstances which characterize the disease. These symptoms arise from the compression of the arterial trunk and the accompanying nerve. In the first days or weeks of the disease, there is little pain or weakness, and the pulse is of its natural strength; but, in proportion as the blood escapes from the artery, and the tumor forms, it becomes coagulated, the tumor gradually becomes larger and firmer, the distention then causes pain, the artery and nerve are at the same time compressed, and, the circulation being interrupted, the pulse becomes feeble and the limb cold, weak, and pained.

We thus perceive that the symptoms of false aneurism are of two kinds. In the commencement, there is a distinct pulsation, and the tumor can be diminished by pressure; but whether this

arises from the blood being returned into the artery, or from being forced into the surrounding cells, I am unable to determine. At this period the artery and nerve are uncompressed, the heat and pulse are natural, there is no pain, and the strength is entire. In a more advanced stage of the disease, the pulsation ceases, and the blood cannot be returned, the pulse in the lower part of the limb beats languidly, or is altogether suppressed, the limb is cold, and almost paralytic, and there is great pain.

3d. VARICOSE ANEURISM.

In false aneurism situated at the bend of the arm, and arising from venesection, the disease is produced by the lancet transfixing the vein and fascia and entering the artery. The blood is effused under the aponeurosis of the biceps muscle, the wound in the aponeurosis is pushed away from the opening in the artery, and raised up by the effused blood. This membrane is thus interposed as a partition betwixt the artery and the vein, through which it was wounded. The external wound heals, and the blood is confined under the aponeurosis as in a sac, and thus the common circumscribed aneurism is formed. But sometimes when the vein is transfixed, and the aponeurosis and artery wounded at the same time, they all inflame at the same point, and adhere; a passage

is by this means formed betwixt the artery and the vein, which permits the arterial blood to pass into the latter by a direct opening. The common false aneurism is thus prevented, and what has been called varicose aneurism, or aneurismal varix, substituted in its stead. This, therefore, is a pulsating tumor of a vein, produced by the arterial blood passing by a direct communication into the vein in consequence of a wound.

This species of aneurism has been so rare, that it is not taken notice of till the time of Dr. Hunter. It is only about sixty years since he first made known the disease. Still there is every reason to believe, that it had sometimes occurred in the practice of the older surgeons, as they frequently speak of the rushing sound of arteries,—a circumstance quite peculiar to varicose aneurism, and which does not occur in any of the other kinds. Varicose aneurism may present itself in any situation where a vein is placed over an artery, and accordingly the disease has been observed in various parts of the body; but, for obvious reasons, it is most commonly met with at the bend of the arm. It differs from true and false aneurism in this respect, that no part of the blood is ever coagulated, but always remains fluid, as it continues always in the course of the circulation.

As soon as the adhesion has taken place betwixt the vein, aponeurosis and artery, the communication is direct, and the blood flows into the

vein, which is not able to resist the force of the artery, and therefore dilates into the tumor of a conical form, situated in the median basilic, although all the neighbouring veins are more or less enlarged. The arterial blood flows into the vein, not in a quiet stream, nor with a full pulsation, but with a rushing noise like the hollow sound of a cistern pipe, very perceptible upon applying the ear. The motion in the tumor is tremulous, and is greatest at the wounded point, but gradually becomes less as the swelling terminates in the continuous vein.

The marks which characterize varicose aneurism, are so decisive that it cannot be mistaken. If the brachial artery be compressed above the tumor, the aneurism becomes flaccid, and all pulsation immediately ceases. If in this flaccid state the finger be applied directly over the cicatrix in the tumor, although the pressure be removed from the artery, the swelling remains flaccid, but immediately fills upon withdrawing the finger. When the arm hangs by the side, the tumor is most considerable, and when it is held perpendicularly up, the swelling almost disappears. If we apply a ligature to the middle of the forearm, and empty the veins above the ligature, by pressing the blood with the hand forward, to the heart, whenever the hand is withdrawn the veins are again immediately filled, and a whizzing noise is heard. This filling of the veins can happen only through a wound in the artery, as the ligature cuts off the

communication betwixt the upper and the lower parts.

In this disease the arm loses part of its power, and the distension occasions a degree of pain. The tumor never becomes very large, but its bulk is proportioned to the power of the artery and the size of the opening in it. The artery is always enlarged above the wound, and diminished below it, the pulse is therefore stronger in the upper part of the arm, and weaker at the wrist than in the limb of the opposite side. This is the natural consequence of the wound in the artery. By opening one part of a system of vessels, the flow of blood is increased towards these vessels and reduced in others,—therefore, by the quicker transit of the blood from the artery to the vein, the artery is enlarged above and diminished below the wound. This is the reason why, when hemorrhagies are once begun, they have a tendency to continue,—why the artery in varicose aneurism is enlarged,—and why an artery tied with a ligature, whether in aneurism or in a stump, in place of being enlarged, shrinks and is converted into a ligamentous cord; in this last case, while the extremities of the tied artery continued to act, there was a continual demand for more blood, the blood behind rushed into the trunk, and the more the extremities acted, the greater was the demand; but no sooner is a check put to the circulation in it, than the artery shrinks and is converted into a firm cord.

Concerning the issue of varicose aneurism and the conduct of the surgeon, Dr. Hunter was of opinion, that as the tumor produced little distress to the patient, and that as there was no danger of bursting, the dilatation would at last stop, and that it would become a stationary disease. Hence he thought there was no motive for operation. The reason that the tumor remains of a stationary size is, that the wound in the artery is stationary, that it always continues the same, and that whenever the vein has dilated so as to transmit the additional blood, the dilatation never will increase unless the wound in the artery should become larger.

Dr. Hunter's opinion of there being no necessity for an operation, is justified by the event of several cases, where the disease has remained stationary for fifteen or twenty years; and Dr. Chester relates the case of one who had the complaint forty years, during all which time there was no increase. Surgeons in general adhere to Dr. Hunter's opinion, but there are some cases related by Brambilla in the Acta Vendebonensis* which were cured by compression. When this method is had recourse to, it should be employed early, and the pressure must be so strong as to lay the sides both of the vein and artery in contact. To prevent accidents, the arm should be kept as much as possible at rest; but if the tu-

* Vid. Acta Vendebonensis, Tom. 1st.

mor should burst from a blow, or otherwise, the artery should be laid bare, and tied above and below the wounded point, as in the operation for false aneurism, by opening the sac.

Complication of False and Varicose Aneurism.

It sometimes happens, that instead of the arterial blood flowing directly into the vein, it first passes abroad into the cellular substance immediately surrounding the artery, and then into the vein. In this case, the cellular substance, as well as the vein, is dilated so as to form a circumscribed tumor, which is quite distinct from that of the vein. Thus, there is a complication of the common false aneurism with varicose aneurism. Immediately after the artery is opened, if the arm be firmly bound up with a compress and bandage, both vessels will be brought into contact, and will at the same time inflame and adhere; if the orifices are exactly opposed, the communication will be so direct as to permit the blood to pass freely into the vein, forming the varicose aneurism; but if the pressure has not been so great as to lay the artery and vein in contact, the blood will readily escape into the cellular substance, dilating it into a tumor, and then pass into the vein.

Reflecting upon the consequences of wounding the artery by transfixing the vein, such a complication of the disease as has now been describ-

ed might have been foreseen; but it was not observed in practice till a case occurred to Mr. Park in the Liverpool Hospital. In his patient, there was situated immediately over the artery, a hard, circumscribed, pulsating tumor, the size of a walnut, and in conjunction with it, a considerable dilatation of the basilic vein. About a year after the commencement of the disease, in consequence of over-exertion, the arm inflamed and swelled, and the tumor burst, so as to call for immediate operation. Upon opening the tumor in the vein, an orifice was seen upon its posterior surface, leading into the second tumor. Into this a probe was introduced, but could be passed upwards and downwards to no greater extent than half an inch. This second tumor was then laid open, when, at the bottom of the sac, another orifice was observed which was found to lead into the artery. The blood was cleared away, and the artery tied both above and below the orifice with success. Dr. Physic of Philadelphia, has related, in the first Volume of the Medical Museum, a similar case, which was cured by tying the artery above and below the wounded point.

This complication of the disease rarely occurs, but when it does present itself, it generally requires operation. In consequence of continued exertion, the blood is thrown faster out from the artery, than the opening in the vein can transmit it; the aneurismal sac in the cellular substance continues therefore to increase, and ultimately

calls for operation, for the same reason that exists in common false aneurism. In such a case, the preferable mode of procedure is to open the sac and to tie the artery both above and below the wound.

4th. ANEURISM FROM ANASTOMOSIS.

The attention of the profession was first called to this species of aneurism by my late partner and friend Mr. John Bell. It most commonly appears under the skin, chiefly about the head, but is not necessarily confined to that situation, as it has been observed in every part of the surface of the body, and even in the viscera. The disease is sometimes born with children, under the form of a small bluish or mulberry mark, which, as the child grows, increases in size, and at length is attended by pulsation. It also frequently appears in the adult, and can then sometimes be traced to a blow or bruise. While the patient is at rest, the pulsation is frequently not very marked, but always becomes very conspicuous, by the passions of the mind, or after running, leaping, crying, or any agitation, on which occasions the tumor is enlarged and the adjacent subcutaneous veins are in general much swelled. This state of increased excitement is also very perceptible at each menstruation, atwhich time when the skin is cracked or ulcerated, the tumor

often bleeds profusely. We have said that aneurism from anastomosis presents itself under the form of a tumor of a bluish colour,—it evidently contains a fluid, and its structure seems to consist of an enlargement of the smaller arteries and veins, which open into cells situated in the common cellular substance, and resemble the cells of the penis or placenta. From the distension of the tumor, the skin becomes livid, and so thin that it occasionally bursts and bleeds profusely, by which the patient is much reduced, and even his life is endangered. There is at present in the Royal Infirmary of this city, a female, in whom the disease is situated in the great toe; it is so extensive as not only to involve some of the soft parts of the toe, but to extend to those covering its metatarsal bone, as well as that of the adjoining toe. She is now twenty-three years of age, and has remarked, as long as she remembers, an enlargement of the toe, attended by a beating, which was most severe after much walking, and especially in warm weather. About six months ago she unfortunately scalded the toe with boiling water. The sore, which did not heal, is now ulcerated to the extent of a half-crown piece, and from this ulcerated surface there has, on several occasions, taken place a profuse hemorrhage. Attempts are now making to cure the aneurism by compression, but there is a doubt of the ulcer healing, as it exists in a structure, in which there is a diseased action. If it should not

heal, if the compression fail to remove the disease, and if the hemorrhagies continue, it will be necessary to take away part of the foot, as the disease is so situated, that the tumor itself cannot be removed by the knife. It is obvious, that unless both the anterior and posterior tibial arteries were tied, the tumor would still pulsate, as their communication is so free, and, that to take up both would prove fatal to the foot.

There are two ways of curing aneurism from anastomosis, viz. by compression and by operation. Compression has been tried in many cases, and in some instances with success. When the tumor is situated upon the cranium, in the forearm, or leg, or wherever it can be firmly compressed, the mode of practice by compression will generally succeed; but the most effectual way of curing the disease is to cut it out, when the tumor is so situated that the operation can be effected with safety. In the dissection, the surgeon should always keep at some distance from its base. By adopting this procedure, there will be little hemorrhage during the operation, and after it the surgeon will have to secure only one or two arteries; whereas, when he cuts close upon the tumor, the hemorrhage is considerable, and the vessels which require to be taken up are numerous. When the aneurism occupies such a situation that it cannot be removed by the knife, as when situated in the orbit, it has been found that the disease has been cured by placing a ligature on the

main arterial trunk, leading to the seat of the disease. Hence, Mr. Travers of London, and Mr. Dalrymple of Norwich, both cured aneurism from anastomosis situated in the orbit, by putting a ligature round the common carotid of the affected side. But although these practitioners succeeded in effecting a cure, the same practice failed in the hands of Dupuytren. He tied the external carotid artery in a young man of 25 years, labouring under aneurism from anastomosis situated in the lobe of the right ear. The tumor by degrees considerably diminished in size, but afterwards became stationary, and soon began to enlarge. It was at length cured by compression.

SPONTANEOUS CURE AND MEDICAL TREATMENT OF ANEURISM.

That power, inherent in the animal economy, by which, when a disease can no longer be resisted, a new process is instituted to supply a loss, and restore a natural function, is in no circumstances more beautifully displayed, than in the spontaneous cure of aneurism. Although aneurism be a dangerous disease, it is by no means necessarily fatal. Its spontaneous cure has now been so often observed, that the occurrence is recorded and attested by all the practical writers of the present day. It occasionally happens in internal as well as external aneurism, and does

not appear to be effected by one uniform mode of operation. Sometimes the channel of the artery remains pervious, and the circulation goes on uninterruptedly,—at other times it is obliterated, and the circulation is then maintained by the collateral and anastomosing branches.

There appear to be four ways in which the spontaneous cure of aneurism is effected. *1st*, The blood which enters and passes through the sac, being removed from the course of the circulation, deposits its coagulating lymph in successive layers. These gradually prop up the walls of the sac, which after a time becomes quite full; and the coagula too, become so firm that it no longer yields, but is enabled to resist the force of the heart. After it is entirely filled, no farther deposition takes place, because the blood is now retained in the channel of the artery. The artery therefore remains pervious, the coagula become smooth towards its cavity, and all communication betwixt the sac, and the artery being cut off, the former no longer yields, and thus a natural cure is effected. *2d*, Sometimes the aneurismal tumor, in the course of the disease, so far changes its position as to press upon the artery, either as it enters into or passes out of the sac. In such a case, the flow of blood in the artery is obstructed, the circulation is thrown upon the collateral branches, and a spontaneous cure effected. *3d*, When an aneurism is large, and the skin which has suffered much distension

inflames, the inflammation extends to the cellular substance, to the artery and adjoining structure; the whole inflamed parts fall into gangrene, and, when the slough separates, the aneurismal artery is closed; the circulation is carried on by the collateral branches, and the ulcerated parts heal by granulation and cicatrization. And *4th*, A cure is sometimes effected in consequence of a portion of the coagulum in the inside of the sac becoming loose by the force of the flowing blood, of its falling off from its surface into the cavity of the artery, and of its plugging up its channel, by which means the circulation is thrown upon the collateral branches.

In the first of these methods of cure, when the sac fills up by coagulated blood, and the channel of the artery remains pervious, the tumor shrinks and gradually becomes smaller, the more fluid parts of the coagula are absorbed, and what remain become in some cases so firm as to resemble a ball of wood. It is evident, therefore, that the aneurismal tumor can now yield in no degree to the stroke of the artery. In the course of time it loses considerably in bulk, though it still retains its pulsation, because the cavity of the artery remains free, but it only pulsates in the same manner as any other tumor would do which was in immediate contact with the artery. This process by which the spontaneous cure of aneurism is sometimes effected, may occur in false as well as in true aneurism, and it appears to be in

this manner that aneurism of the aorta is cured, as is exemplified by cases recorded by Messrs Freer and Hodgson. It is evident that whatever lessens the force of the general circulation, will not only check the progres of the dilatation, but, by diminishing the rapidity of the flow of blood through the sac, will favour the deposition of coagulating lymph,—hence repeated bleedings, conjoined with low diet and rest will materially assist the operations of nature in effecting a cure, and it is upon this principle that Vasalva and Albertini* sometimes cured aneurism, by a rigid system of depletion and abstinence. This system has been more freely adopted by Pelletan, surgeon of Hotel Dieu of Paris, than by any other surgeon of the present day, and the cases recorded by him justify the practice. †

In all cases of internal aneurism, repeated bleeding should be had recourse to, and proportioned in frequency and quantity to the age of the patient and force of the circulation; abstinence from all animal food, spirituous and fermented liquors should be strictly enjoined; for diet, nothing more should be allowed than what is barely sufficient to support life, consisting of a stated allowance of bread, milk, vegetables, fruits, and tea; and for drink, nothing stronger than water. The patient should refrain from exercise

* See Morgagni, Letter XVII. Art. 30.

† See Clinique Chirurgicale, Tom. I. par. Ph. I. Pelletan.

of every kind, and confine himself as much as possible to one posture. All emotions of the mind, or whatever can accelerate the circulation, must be studiously avoided. The frequency of the pulse may be diminished by digitalis, and the bowels should be kept open by means of the supertartarate of potash or any other saline cathartic. As local applications, if the skin is at all inflamed, saturnine solutions are the best,— if not inflamed, strong decoctions of oak bark with alumn should be had recourse to. These harden the skin, render firmer the coagula, and diminish the size of the tumor. Pelletan gave the preference to pounded ice. By pursuing these measures, the surgeon will sometimes enable nature to effect a cure, but even when they prove inefficient, they will unquestionably prolong life and render it more supportable.

The second method by which the spontaneous cure of aneurism is sometimes effected, is by the tumor changing its position so far as to press upon the artery, either as it enters into or passes out of the sac. This is equivalent to an operation, or to external compression by which the sides of the artery are laid together. In such a case, the flow of blood through the artery is prevented, there is for a time a diminished temperature of the limb, the circulation is thrown upon the collateral arteries, which enlarge, and the blood in the sac coagulates and is gradually absorbed, so that the tumor shrinks and becomes a small hard

knot. The sides of the artery adhere above and below the tumor, till the issue of the first branches, and for that space the vessel degenerates into a firm cord. This method of cure has no doubt occasionally presented itself, but it so rarely occurs, that it cannot be considered as the general way in which the spontaneous cure of aneurism is accomplished.

The third manner in which the spontaneous cure of aneurism is effected, is by the inflammation of the skin, that is excited by the extreme distension, terminating in gangrene, so extensive as to involve the aneurismal tumor and adjoining structure. The pulsation in the tumor ceases, the limb becomes cold, and the circulation is thrown upon the collateral branches. In this case, the same process takes place as when mortification succeeds to inflammation on any other occasion. The inflammation, which is so excessive in the tumor and adjoining structure as to terminate in gangrene, produces adhesion in the aneurismal artery and other blood vessels which immediately lead to the seat of the mortification. The limb which had become cold regains its heat as the collateral circulation is established; when the dead parts separate, there is a discharge of the grumous blood which was contained in the aneurismal sac, and which, when the sac is large, is in considerable quantity; and the artery is not only secured by adhesion, but, as in other mortifications, plugged up to some extent with coagu-

lated blood. When the mortified parts are completely separated, the basin of the sore fills up by granulation, and the ulcer at last cicatrizes. This manner of spontaneous cure occasionally occurs in the extremities, and there are several cases on record, particularly by Wiseman, Guattani, and Mr. Hodgson. Sometimes the constitutional irritation is so excessive, that the patient dies before the process is completed; and on other occasions, if the gangrene is not so extensive as completely to involve the tumor, a fatal hemorrhage succeeds upon the separation of the slough. This method is therefore by no means a desirable interposition of nature to effect a cure; indeed it rarely occurs, and when it does, the patient generally dies before it is completed. He sometimes dies of hectic fever produced by the constitutional irritation and discharge, and he is even apt in his debilitated state to die of hemorrhage, which sometimes takes place from a communicating branch upon the separation of the slough. In one case which came to my knowledge, three pounds of blood were lost from a vessel which was opened by the separation of the mortified parts, but the hemorrhagy had ceased before the surgeon arrived, and the patient recovered.

The fourth manner in which we stated that the spontaneous cure of aneurism was sometimes effected, was by a portion of the coagulum being detached from the inside of the sac, falling into the cavity of the artery, and plugging it up,—by

which means the circulation is thrown upon the collateral branches. This appears to me to be the way in which the spontaneous cure of aneurism of the extremities is most frequently accomplished. A portion of coagulum may be detached and fall into the cavity of the artery in consequence of the force of the flowing blood, or by a change of position of the limb; or it may be forced into the cavity of the artery by external compression upon the tumor. I observed, that in aneurism of the aorta near the heart, the coagula were sometimes moved from the sides of the sac and carried into the artery, which was consequently plugged up, and that the patient then immediately died as quickly as if he had been suffocated. There is every reason to believe that the same thing frequently takes place in aneurism of the extremities, but the effect is different. This kind of obstruction produces instant death in the aorta, but in the extremities only a change of circulation. When a loose clot falls into the cavity of the artery, the pulse ceases and the limb immediately becomes cold. It remains so for a day or two, when it begins slowly to recover its heat, and the pulse also returns. The circulation is at last completely re-established and the strength of the limb is restored. The change that has happened is equivalent to an operation, the artery is stopped up, and the circulation is thrown upon the collateral branches, which, by a law of the animal economy, immediately enlarge so as freely to

transmit the whole blood sent to the limb. The blood having now an easy and direct course through the collateral branches, does not enter the main artery closer to the aneurismal tumor than the nearest large communicating branch either above or below; it therefore coagulates in this part of the artery as well as in the tumor, it soon begins to be absorbed, the artery contracts, and the sac becomes flaccid. The artery continues contracting, till at last it adheres and becomes a hard cord throughout the whole space betwixt the first large branches communicating with its cavity above and below the seat of the aneurism. The sac gradually decreases in size by a slow absorption, till it degenerates into a hard lump which continues during life, but which is no incumbrance to the limb, and is devoid of pulsation, because the artery is impervious. This obliteration of vessels in the human body, when the course of the circulation is changed, is well illustrated by the contraction and obliteration of the ductus arteriosus and umbilical vessels after birth.

Mr. Hodgson imagines that the spontaneous cure of aneurism is in most instances effected by the deposition of the coagulating lymph, both in the aneurismal sac and in the portion of the artery connected with it. He conceives, that after the sac has been completely filled with coagula, the deposition still goes on in the channel of the artery, which supplies the disease, till it is

completely plugged up by coagulum extending on both sides of the sac, to the next important branches given off by the artery; that then, as we have already explained, the flow of blood being obstructed through the main artery, the circulation is thrown upon the collateral branches, which gradually enlarge so as to supply the place of the main trunk; and finally, that the coagula are removed by the absorbents both in the artery and sac, till the former contracts into an impervious cylinder, and the latter into a small fleshy tumor.

Mr. Hodgson is an accurate observer, and has presented the profession with an admirable work containing many valuable remarks on the diseases of the vascular system, but I cannot help thinking that his conclusions are erroneous, with regard to the blood continuing to deposit its fibrin or coagulating lymph in the artery after the sac is filled up; and I imagine that the commencement of the process towards a spontaneous cure, depends rather upon a portion of the coagulum being detached from the sac, and falling into the artery and plugging it up. My reasons are as follows: 1*st*, It is not easy to conceive how the blood should coagulate in the artery, as it is within the course of the circulation, and in no parallel case does it do so. The force of the flowing blood would prevent its coagulation, and the clot which might at any time be formed, would be carried along the artery and obstruct it at a lower point.

2d, The cases of aneurism of the aorta, which Mr. Hodgson himself relates, prove that the deposition of coagulating lymph never extends into the artery, but that, whenever the sac is filled up, the coagulum becomes smooth towards the channel of the artery. And, *3d*, If the blood continued to deposit its coagulating lymph in the artery after the sac was filled up, there never would be any change in the temperature of the limb when the artery became obstructed, because this deposition is a slow process, and in proportion as the flow of blood through the aneurismal artery was prevented, the collateral branches would gradually enlarge. In the early stage of the process, each branch would transmit its due proportion of blood, and before the obstruction in the main artery became complete, the collateral branches would have so much enlarged as freely to transmit the blood,—consequently in this case, there never would be any change in the heat of the limb; whereas, I believe, the actual fact to be, that in the commencement of the spontaneous cure, when arising from obstruction in the artery this change is always observed. In all those cases which I have seen, the limb lost its heat and feeling as suddenly as if the artery had been obstructed by a ligature, and it required a day or two to regain its former temperature. The reason that coagula have been found in the artery, as well as in the sac, in those cases which have been examined after death, is evident. No sooner

is the artery obstructed by a clot of blood, than the circulation is thrown on the collateral branches, which immediately enlarge. The blood, finding a free rout through them, does not continue to flow into that part of the artery, which is situated betwixt the origin of the nearest important branches above and below the aneurismal tumor, and that portion of blood again which is already in it, coagulates in the same manner as it is always found to do in the extremities of the arteries of a stump up to the issue of the nearest branch. From these considerations, then, I am led to conclude, that till the artery is in some way or other obstructed the blood never coagulates in it.

SURGICAL TREATMENT OF ANEURISM.

While the medical treatment of aneurism, by favouring the coagulation of the blood in the sac, sometimes effects a cure, the surgical treatment accomplishes the object by more direct means, and with a greater degree of certainty. This treatment consists in obstructing the flow of blood through the artery leading to the aneurismal sac, or through the sac itself. The circulation, thus obstructed in the main artery, is thrown upon the collateral branches, which, by a law of the animal economy, immediately enlarge, till they are capable of transmitting the whole quantity of

blood formerly conveyed by the trunk. The blood in the sac coagulates, and is then gradually absorbed, the tumor shrinks till it becomes a hard knot, and the process induced in the obstructed artery leads to its permanent obliteration. It can no longer convey the blood, which is now transmitted by the enlarged collateral branches, and the limb is in future supported by the establishment of a new circulation.

Various methods have at different times been proposed and put in execution for the cure of aneurism, but, with whatever intention they were adopted, we may lay it down as a fundamental rule that they all operate in one way, viz. by obliterating the channel of the artery, and forcing the collateral branches to enlarge, so that the circulation may be maintained in the limb.

The older surgeons had three chief methods of cure. In the first they had not recourse to the knife, but applied to the tumor tourniquets, compresses, cushions, and spring hoops. They conceived that they effected a cure by healing the wound in the artery, (as in brachial aneurism), and that the blood still continued to follow its natural course. There is a machine for the cure of aneurism delineated in Scultetus; and Dionis informs us of a bandage invented by Bourdelot, first physician to the king of France, which he himself wore for twelve months in consequence of aneurism arising from bleeding. He called it a *ponton*, imagining that it did not obstruct the

passage of the blood through the artery, but allowed it to flow under the instrument in the same manner as a river flows under a bridge.

In the second method, they opened the aneurismal tumor, cleared away the blood, and laid upon the artery a small bit of the sulphate of copper, with compresses according to Heister or bits of chewed paper according to Dionis; and it appears, that by this operation, they expected, as they did by external compression, a re-union of the wounded artery, while, in truth they effected a cure by laying its sides together and obliterating the canal.

In the third method, they opened the tumor and tied the artery, but in this plan of treatment they had no confidence. They did not suppose that the collateral branches could enlarge, or they imagined that they did so very slowly, and with great risk of mortification. When they opened the wound, and tried to cure by compression, they were often compelled to undo the dressings on account of bleeding, and to apply them again tighter and tighter by degrees; they were also compelled to apply long compresses in the course of the artery, to moderate the force of the blood, a practice which must have compressed the collateral branches, and curbed the free circulation of the limb.

In the surgical treatment of aneurism, the moderns have employed two methods of cure, compression and the ligature. Compression has been

long used, and is recommended by all the earlier writers. It may be applied either to the tumor, or to the artery leading to it. When applied to the tumor in true aneurism, it seems to effect a cure by forcing the coagula from the sac into the channel of the artery, and thus obstructing the flow of blood through it,—hence it cannot be so certain in its operation as when applied to the artery above the tumor. When the artery is compressed above the tumor, its sides are laid in contact, but whether the artery from this pressure first inflames and adheres, and a cure is thus effected upon the principle of the ligature, or whether the sides of the vessel merely remain in contact, and, in consequence of the obstruction, the blood in the sac first coagulates, and the obliteration of the artery follows as a secondary part of the process, as in the spontaneous cure of aneurism, I am unable to determine. I am rather inclined to be of the latter opinion, from the circumstance of a cure being often effected, although the pressure is not so strong as entirely to stop the flow of blood in the artery, and although it cannot be kept continually applied but must be occasionally remitted in consequence of the pain which it excites.

In true aneurism, compression does not promise so much success when made on the tumor, as when applied to the artery above it. The preferable practice is to make pressure on the artery, but, whether it be made upon the tumor or

upon the artery, it should not extend to the whole circumference of the limb. When the limb is compressed in its whole circle, the compression extends to the anastomosing branches upon which the safety of the limb depends. Independently of this circumstance it involves the veins and lymphatics, and swells the lower part of the limb. It is also of consequence to mark the exact point to which the compression should be applied. The artery should undoubtedly be compressed as near the sac as possible, otherwise the communicating branches will carry the blood into the artery above the sac, and, the circulation in it being thus still kept up, the blood in the tumor will not coagulate.

Guattani who was a great advocate for compression in the case of aneurism, by means of it in three months effected cures of a porter and a sexton who had the disease in the ham. He first applied to the ham two large and firm compresses, and then laid compresses all along the femoral artery, and bound them down with a tight roller three inches broad. He applied the roller anew every eighteen or twenty days, and always a little tighter. With this local treatment he combined general bloodletting, rest, and spare diet; but he seems never to have had any idea that he obliterated the artery, and established a new circulation, thinking he only reduced the tumor, while the original circulation was preserved. By a similar mode of treatment, Guattani effected the

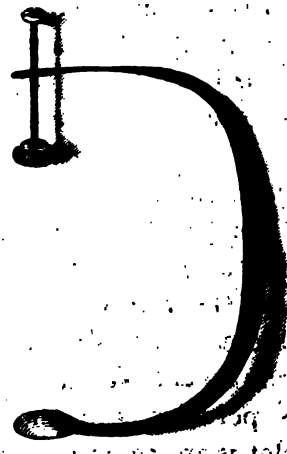
cure of other two cases of popliteal aneurism, and compression has been more recently employed with success by several of the French surgeons, particularly by Dupuytren and Dubois. These gentlemen apply the pressure to the artery above the tumor, and merely compress the artery and the opposite point, leaving the rest of the limb free. In September 1816, at Hotel Dieu, Dupuytren shewed me a case of aneurism of the femoral artery, situated in the groin, close upon Poupart's ligament, and which he was attempting to cure by compressing the external iliac. The patient was a hale man, about fifty years of age, and the tumor was about the size of a hen's egg, having a strong pulsation visible both to the eye and touch. When M. Dupuytren pressed with his hand upon the artery within the pelvis, and I applied my fingers to the tumor, I could not discover the least pulsation. The patient rested upon his back, his loins and hips were received into a well padded machine, shaped like a saddle, and a curved bar of iron came up from this machine over the left groin, where the aneurismal tumor was situated. Into this bar, a piece of iron slipped like a bolt, upon the end of which was a pad which rested upon the anterior and lower part of the abdomen above the tumor, and the compression was made with this pad by means of a screw, through the abdominal muscles, a little above the tumor, upon the external iliac artery. M. Dupuytren had cured an aneurism of the popliteal

artery a short time before, by compressing the femoral artery in the middle of the thigh. Dubois has also cured several external aneurisms by means of compression, and, in particular, one situated in the left popliteal artery. The compression was applied to the artery on the fore part of the thigh on the 25th of February, and the patient was presented to the Faculty of Medicine at Paris, on the 29th of the following March, completely cured.*

We have already remarked that it is preferable to apply the compression to the artery above the tumor, instead of to the tumor itself; that the pressure should be applied at no great distance from it; and that it should be confined as much as possible to the artery, and not involve the whole circumference of the limb. If the compression should produce pain, which it frequently does when long continued, it will be necessary to remit it occasionally; but this should be done no longer than is absolutely nccessary, as it is only by long continued pressure that a cure can be effected. Various contrivances have heen resorted to, in order to effect the compression of the artery, without obstructing the circulation in the collateral branches; but the most simple form of instrument for this purpose, is that which is deli-

* For the statement of this case, illustrating the manner in which the compression was applied, see Bulletins De La Faculté De Medicine, De Paris, Tome, 2d.

neated in the marginal plate, and which is the invention of Mr. Moore of London.



It consists of a semicircular piece of iron, covered with leather,—at one extremity is fixed a screw, with a flat pad,—and by turning this screw, pressure can be made to any extent upon a compress placed upon the artery. At the opposite extremity is placed another pad or cushion, which presses on the point of the limb directly opposite to the compressed artery. A piece of firm dry sponge forms the best compress that can be applied to the artery, as it possesses a degree of elasticity; and, to render the compression effectual, it is necessary that there should be a bone on the opposite side of the artery, against which it can be pressed.

Although Guattani, Petrus Javina, Leghius, Flaganus, Dupuytren, Dubois, and many other

surgeons have cured popliteal, as well as other aneurisms, by compression, still that species of the disease which arises from a wound in the artery, as brachial aneurism, is the only proper case for its application, and when employed early in it, the practice is generally successful. When this method of cure is adopted, we bleed frequently, and enjoin a low diet, with complete rest. In this case the compression must be made upon the tumor, and it must be so great as to lay the opposite sides of the artery in contact, so as to make them adhere. If this is not attended to, a clot of blood fills up the wound in the artery, the vessel remains pervious, and the cure is incomplete, as this clot is apt to be forced out upon any blow or violent exertion.*

The second method of cure, under the surgical treatment of aneurism, is by the ligature, or tying the artery, usually called the operation for aneurism. This operation is established upon such certain principles, is so simple in its execution, and has been performed by the surgeons of the present day with such marked success, that it

* Examples of the cure by compression, of aneurism arising from bleeding in the arm, are related by Foubert in the 2d volume of the Memoirs of the French Academy of Surgery, —by Brambilla, in the Acta Vendebonensis,— by Cagnion, in the 2d volume of the Parisian Journal,—and by several other writers.

may be accounted a perfect operation. The experiments of Dr Jones* have demonstrated that the first effect of a ligature, when pulled moderately tight upon an artery, is to cut through its internal and middle coats, and that in consequence of this wound, an action founded on the laws of inflammation follows, which leads to its permanent obliteration. As soon as the flow of blood is obstructed in the artery, the circulation is thrown upon the collateral branches, which gradually enlarge; the circulating blood no longer passes into the obstructed vessel, below the origin of any considerable branch which happens to come off nearest to where the artery is tied, because the transmission is so free that there is no resistance; and the blood therefore coagulates in this part of the artery,—hence in every artery which is tied with a ligature, whether upon the surface of a stump or otherwise, a clot of blood is found immediately above the ligature, except in those cases where it happens to be applied close to the origin of a large branch. This clot is an additional security to the artery, preventing the action of the flowing blood upon the ligature, and lessening the risk of hemorrhage.

Upon the division of the arterial coats by the ligature, inflammation follows, which, according

* See a Treatise on the process employed by nature in suppressing the hemorrhage, from divided and punctured arteries, and on the use of the ligature, by J. F. D. Jones, M. D.

to its violence, terminates in adhesion, or ulceration. When the inflammation is moderate, it terminates in adhesion, because the structures involved are of that nature which when inflamed have this termination. In consequence of the inflammatory action, an effusion of coagulating lymph or of the albumen of the blood takes place, both into the cavity of the artery, betwixt its coats, and on its external surface in the immediate vicinity of the ligature, which produces adhesion and permanently closes the artery. That portion of the external coat which is embraced by the ligature dies and sloughs off, the ligature is thus separated, and the artery is secure. The coagulum of blood is gradually absorbed, and as no fluid blood passes into it, the vessel shrinks and becomes a firm cord, as far as the origin of the nearest considerable branch on both sides of the ligature, the same process taking place both above and below the point where the artery is tied. Although the division of the internal and middle coats of an artery follows the application of a ligature when drawn tight, and ensures the obliteration of the vessel, it by no means follows that this division is necessary to the success of the operation,—for if this were the case, no vessel would be permanently closed, unless the internal and middle coats were divided. Now we know that a wounded artery will adhere when compressed, and that it will even do so when a considerable portion of the soft parts is included in the li-

gature so as to prevent the division of the internal and middle coats,—although, I admit, not so readily as when these coats are divided.*

Since adhesion succeeds to the division of the internal and middle coats of an artery, if the inflammation is moderate, it follows, that all those means which can ensure this division and prevent an excess of inflammation, should be put in practice. These ends are effected, chiefly by the form of the ligature, and the manner of its application. The ligature should be round and not flat, of a thickness proportioned to the size of the artery, and tied with a single knot, which permits it to be more closely drawn than when tied by the surgeon's knot, and does not pucker the vessel†. It

* The cases recorded by Mr Crampton, also shew that the division of the internal and middle coats of an artery is not necessary to its permanent obliteration. See Medico-Chirurgical Transactions, volume 7th.

† If the ligature is thick and tied by the surgeon's knot, the sides of the artery will not be brought into close contact, and consequently the flow of blood will not be completely suppressed. "Chopart operated upon a gardener for popliteal aneurism, in presence of the most distinguished professors of the ancient school of surgery. The ligatures being placed, and the first of them being tied by the surgeon's knot, the compression was removed, but the blood flowed copiously; a second and a third ligature were applied in the same manner, with as little success. After some little deliberation, this accident was attributed to the ossification of the artery, or to some other unknown state,—amputation was determined on, and immediately performed. Upon examination of the limb, the

should be pulled pretty tight, and the artery should be tied clear of the surrounding parts,—all these precautions tending to ensure the division of the internal and middle arterial coats*. To keep the inflammation moderate, upon which the success of the operation greatly depends, the artery should be disturbed as little as possible, and separated from its surrounding connections to no greater extent than what is just sufficient to permit the ligature to be passed. The ligature should be single, but if the artery has unfortunately been insulated to some extent, or if, from its deep situation, it was necessary to make it so, two ligatures should be used instead of one. These should be tied as far

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artery was found in its natural state, it was embraced by the three ligatures, but although they had been pulled with great force, none of them had completely effaced the cavity of the vessel, so that a large stilette easily passed into it." See Traité des Maladies Chirurgicales, et des Operations qui leur conviennent. Par M. Le Baron Boyer, Tom. 2d. p. 138.

* As there has been much discussion in the publications of the present day, with regard to the manner of knotting the ligature, and cutting it close to the artery, or allowing it to hang from the wound, I think it right to state, that my master, Mr. John Bell, has, in all his writings, inculcated the propriety of preferring the single to the surgeon's knot, and that twenty-six years ago, when I was his apprentice, it was his invariable practice to tie arteries with a single knot instead of the surgeon's knot. It was also his practice in operations particularly after the extirpation of the female breast, to cut the ligature short and then to close the wound. I never knew this practice prevent adhesion, nor ever saw it followed by any bad consequences.

apart as the separated artery will permit, and the vessel should then be divided betwixt them. I hold this direction to be of some importance, because when the artery is much separated from its surrounding connections, the arteriæ arteriarum, or those vessels which supply it with nourishment, are so much torn, that the vessel instead of adhering, extensively inflames. It is then apt to ulcerate, and there succeeds a hemorrhage about the 12th or 15th day. Upon dissection, the ulceration of the artery is generally found close above the ligature, the vessel, for the space of several inches above it and below it, is considerably thickened in its coats, and its inner surface to the same extent much inflamed. I have seen this ulceration of the artery occur more than once, where it had been much separated, and where one ligature was used. With the same view of preventing an excess of inflammation, nothing should be interposed betwixt the ligature and the artery,—as all foreign bodies of whatever nature excite an irritation which is apt to terminate in ulceration instead of adhesion.* After the ligature is secured, the wound should be immediately closed. These doctrines are founded upon the laws and operations of the animal body, and are justified by experience.

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* For a view of the practice of the French surgeons, in the operation for aneurism, see the foot note to Adhesion, volume I. p. 60 and seq.

In the operation for aneurism, there are three situations in which the ligature has been applied, —namely, in the immediate seat of the disease, above the tumor, and below it. In the first of these operations, which is the most ancient, and which was universally practised for the cure of true aneurism before the time of Mr. Hunter, and continued in false aneurism till within these very few years, the tumor is opened, the blood cleared away, and two ligatures are applied, one immediately above the breach in the artery, and the other immediately below it. The effect of the upper ligature is to stop the direct flow of blood into the aneurismal sac, and the use of the lower one is to prevent hemorrhage arising from the return of the blood by the anastomosing branches. In consequence of the interruption to the circulation, the blood, as we have already explained, seeks a new course, the collateral arteries enlarge, and the pulse, heat, feeling and use of the limb are gradually restored.

When the sac is opened, although the principle is essentially the same, there is some little variety in the operation, according as the aneurism is true or false. In true aneurism, as in popliteal, the surgeon first opens the integuments, dissects the tumor all round, and disengages it so completely as to see its full extent. He then passes one ligature immediately above the tumor, and one below,—ties the upper ligature,—then opens the tumor and discharges the coagulated blood,

—and lastly, secures the lower ligature, and dresses the wound. Opening the tumor enables the surgeon to clear away the blood, which reduces it in size, and leaves nothing for absorption; and in the course of the cure, the parts are firmly united so as to form a strong cicatrix.

This is the operation which was universally performed for the cure of popliteal aneurism, before the time of Mr. Hunter, or rather before his new operation; and wherever the state of the parts will admit, it may be safely and effectually performed. But it is only in the commencement of the disease, that the tumor is small, circumscribed and easily dissected. It is very early straitened in the hollow of the ham, the parts become thickened and inflamed, and so knotted together that the tumor is undistinguishable. If in this state of the tumor, the operation be performed in the ham, the surgeon must make a very long incision,—hence there is so tedious a dissection as to cause a slow and painful operation; besides it must be ill performed, for the parts are so mixed and confounded, that they cannot be distinguished nor separated; and after much labour and pain, the surgeon is often obliged to take up the nerve, artery, and vein together, thus endangering a paralytic limb. To this an extensive incurable ulcer frequently succeeds, and the limb sometimes gangrenes. There is also considerable difficulty in securing the artery, if the aneurism is very high or very low. If high, it

can be accomplished only by cutting up the triceps, and extending the incision to the fore part of the thigh; and if very low, by carrying it downwards betwixt the heads of the gastrocnemii muscles.

For these reasons, we prefer taking up the artery above the tumor on the fore part of the thigh. This change in the operation was proposed by Mr. Hunter. It was successfully performed by him, and the value of the operation is now established by the practice of the first surgeons of the present day. Mr. Hunter in changing the place of operation, did not mean it as an imitation of that process of nature which we have explained, when treating of the spontaneous cure of aneurism, as at that time the spontaneous cure of aneurism was hardly known; neither did he change it for the reasons which I have assigned. His whole motive for forsaking the ham, and tying the artery on the fore part of the thigh, was this. He imagined, that aneurismal arteries were diseased in their coats, that the diseased affection extended along the artery to some distance from the sac, and that the reason of the frequent want of success when the artery was tied in the ham, arose from its not adhering, in consequence of the diseased state of its coats,—hence a hemorrhagy occurred when the ligatures came away. Mr. Hunter, therefore, proposed to take up the artery at a higher point, where there was a greater chance of the vessel being sound; and such pro-

bability superadded to the reasons we have already assigned, is a good motive for preferring this operation.

In performing the operation for false aneurism, as for brachial, it has been customary to open the tumor, to clear away the blood, to search for the wound in the artery, then to separate the nerve, and otherwise insulate the vessel at its wounded point; and lastly, to apply two ligatures, one above, and one below the wound. Although the operation has been generally performed in this manner, the improved method of operating for popliteal aneurism, by taking up the artery at some distance above the tumor, and leaving the sac untouched, is equally applicable to brachial aneurism, and, for the following reasons, is undoubtedly the preferable operation. It sometimes happens, that by the impaction of the blood, the artery, the vein, and the nerve are so knotted together by inflammation, that they form a very confused mass, which, if it is possible to unravel, can only be done after a very tedious and painful dissection. In such a case, there is great risk of including the nerve in the ligature. When the parts cannot be separated, it has been the usual practice to take a sharp surgical needle armed with a ligature, to pass it under this thickened mass, and to tie it, including the artery, vein, and nerve. This occasions excruciating pain at the time, and the future consequences are, 1*st*, That the ligature obliterates and makes its way through

the artery and vein, but cannot destroy the nerve, which resists the ligature; and, therefore, if this be well waxed, it will keep its hold for weeks or months, and will not be removed till it either rots or is cut from the nerve. *2d*, Great tension and pain will ensue, accompanied by high inflammation and profuse fœtid suppuration. The inflammation, which is generally of the erysipelatous kind, undermines the cellular substance of the arm, lasting for months. And *3d*, There is great risk of the thumb, fore and middle fingers, to which the radial nerve is finally distributed, remaining contracted and powerless. Again, even in the most favourable circumstances, the surgeon requires to make a large incision, involving the whole of the tumor; there is difficulty in getting out the clots of blood to reach the artery; it is long before the operation is finished; and afterwards there is some risk of the sac suppurating. Considering all these circumstances, I am decidedly of opinion, that the common operation should be abandoned, that the sac should not be opened, but that the artery should be tied two or three inches above its wounded point. This method was practised with success by Anel*, and has been repeated with the same success by succeeding surgeons.

The second situation in which the ligature has

* Suite de la Nouvelle Methode de guerir les Fistules Lachrymales, p. 251.

been applied, is at some distance above the tumor, and, for the reasons we have assigned, this is the preferable place for tying the artery. When the artery is tied close above the tumor, the pulsation in it immediately ceases; but when the ligature is applied at some distance above, the tumor sometimes continues to pulsate, because the blood is brought again into the main artery above the seat of the disease, by anastomosing branches,—the pulsation being in general feeble, as the blood now enters the sac in a diminished stream. In true aneurism, it seems advisable to apply the ligature at some distance above the tumor, as there is a chance of the artery being diseased in its immediate vicinity. In false aneurism, or that arising from a wound, it should be applied at no great distance above it, as the artery is sound. In the former of these cases, as the pulsation is apt to continue in the sac after the artery is tied, compression should always be applied to the tumor with a steady pressure. In the latter case this precaution is not necessary.

The third and last situation in which the ligature has been applied, is below the tumor. When the aneurism happens to be situated so close to the trunk of the body, as not to leave room to apply a ligature betwixt it and the heart, as when the disease is situated high in the subclavian or external iliac, it was proposed by Brasdor and Desault to tie the artery immediately below the

tumor ; and if there happens to be no considerable branch coming off from the sac, or from the artery betwixt it and the ligature, there is little reason to doubt, that this operation will be as successful as when the artery is tied above the aneurism. All that is required, is to stop the flow of blood through the sac, when it will coagulate, and the cure proceed as when the vessel is tied above. But if a large branch happens to come off from the sac, or betwixt the ligature and it, the flow of blood will not be obstructed through the sac, and the operation will be unsuccessful. This operation of tying the artery below the tumor, has been put in practice both by Deschamp, and Mr. A. Cooper,—but by the first, under circumstances of such mismanagement, that no operation could succeed. In the case where it was practised by the latter, it happened that two important branches came off from the artery betwixt the sac and the ligature. The aneurism was situated so high in the external iliac, as to leave no room for tying the artery above the tumor. It was therefore tied in the groin, but the epigastric and circumflex iliac came off betwixt the tumor and the ligature, so that after the operation, the pulsation in the tumor still continued, though the aneurism did not increase. On the contrary, it gradually diminished in size, but at last terminated fatally by bursting. Although no successful cases can be adduced where the artery was tied below the tumor, still the principle on

which this operation is founded is good, and in certain circumstances it deserves a farther trial.

ANEURISM OF PARTICULAR ARTERIES.

External aneurism is a disease which appears to have been well known to the ancients. We can trace histories and descriptions of this dreadful disease, throughout the writings of all the ancient physicians from the days of Galen. But while external aneurism was often remarked, and well described, that species of the disease which occurs in the large internal arteries, and which is always true aneurism, is taken no notice of by any writer, as far as I know, before the time of Vesalius. Both kinds of them are well described by modern writers.

ANEURISM OF THE AORTA AND OTHER INTERNAL ARTERIES.

About the year 1557, Vesalius first pointed out aneurism of the aorta. This affection, however, was not generally described till a century after; but, since the more diligent cultivation of morbid anatomy, it is found to be a disease of very freqnent and fatal occurrence.

Aneurism of the arch of the aorta has been ascribed to its peculiar form. 1*st*, The heart con-

tracting upon the blood propels it with great power and, the action being so incessant, is sufficient to rupture any vessel which is not very strongly secured, especially where there is any tendency to disease in the arterial coats. *2d*, The upper part of the aorta is curved into an acute arch, the blood in rushing forth from the ventricle strikes directly against this arch, and at this dangerous angle three large branches are given off, which must weaken the parent trunk. Thus the foundation of this dreadful disease is laid in the very action of the heart and form of the artery. *3d*, Two great branches, the carotids, run up from the aorta to the neck, and are connected to it by loose cellular substance, so as in some degree to support or suspend the heart. The heart is also partly suspended by the subclavian arteries, which lie unsupported within the chest,—hence by sudden shocks, falls, or blows upon the breast, these arteries are liable to receive such an injury, as not only never to recover, but also to give rise to this fatal disease.

Aneurism of the aorta has been ascribed to the artery wearing thin, or to a peculiar weakness of its coats. It has been more particularly ascribed to the angle and arched form of the descending aorta. It has been also said to be a gradual constitutional disease, when it really often arises from violence done to the artery in accidents; but still the form of the vessel is in some degree a cause.

It is hardly to be credited, how very often falls and blows are the cause of aneurism near the heart, and how frequently the disease occurs in the male when compared with the female. Women are very much exempted from this disease. Now if aneurism arose from weakness, relaxation or a loss of elasticity and tone, they would be more subject to it than men; but it generally arises from shocks, falls, and others accidents,—and therefore men are exposed to it by their way of life, and even by that strength which seems to be their safety. There are few cases on record, where women have had aneurism in the large vessels near the heart. Men are generally its subjects, and seem to be exposed to it by their bodily exertions. Mr Hodgson has given a statement of the number of cases of spontaneous aneurism, which have fallen under his observation. From this statement, it appears, that out of twenty-one aneurisms of the large vessels, immediately connected with the heart, sixteen were males, and only five females; and out of sixty-three cases of spontaneous aneurism, situated in various parts of the body, no less than fifty-six were males, and only seven females. It may be safely affirmed, that in nine cases out of ten, aneurism arises from some external cause, the artery at such a time receiving so great an injury, as to produce a destruction of its fabric, succeeded by inflammation and pain. There is a rupture of its internal and muscular or middle coats, followed

by a yielding of its cellular or external coat, and at last, death.

We cannot deliver a regular history of the symptoms of a disease so various in its form. It is very slow in its progress, and the patient complains long before the cause is ascertained, or the disease is distinctly marked. He generally first complains of a fullness about the breast, with a constant and painful throbbing under the sternum; in a short time, the breathing becomes difficult, and the pulse is irregular and quick; the throbbing increases, and if the patient walks fast, as hurriedly up stairs, speaks loud, or is excited by any passion or emotion of the mind, the throbbing and difficulty of breathing are so great that he faints. There now appears a beating tumor about the root of the neck, or the upper part of the chest, with an aggravation and increase of all the symptoms; there is an uneasy and teasing cough, with great pain in the breast from the increasing tumor, sleepless nights and frightful dreams. The patient is unable to lie on the left side, and there is a sense of choaking and sudden starting from sleep, followed by a spasm about the root of the diaphragm like a rope drawn tight. At last the tumor, still increasing, beats strongly against the chest and forces up the bones; the clavicles, sternum, and ribs are destroyed, when the tumor, no longer supported or opposed, yields before the force of the heart; the skin then inflames, gangrene ensues, the slough gives way, and the

patient expires in a moment. Sometimes the disease proves fatal in a few months, sometimes in a year, but often it continues increasing for several years, with unceasing difficulty of breathing, interrupted pulse, and excruciating pain. The pain, whether from pressure, from the incessant beating of the tumor, or from the yielding of the artery, is very great; and patients compare it to the points of swords run through the breast in various directions.

Aneurism of the aorta may prove fatal in a variety of ways. 1*st*, As the aneurism increases in size it contracts adhesions with the parts with which it is in contact, and from its pressure produces ulceration. When the aneurismal tumor yields by laceration or sloughing, the blood passes through the ulcerated opening into the adjoining cavities, and it is in this way that it sometimes gets into the trachea, fills the lungs, and produces suffocation. The root of the trachea is so connected with the basis of the heart, that the aneurismal tumor and this tube soon come in contact and adhere,—hence bursting into the trachea is by no means a rare occurrence. From the same circumstance, it sometimes bursts into the œsophagus, and sometimes into the pericardium.

2*d*, Aneurism of the aorta may prove fatal, by the coagulated blood loosening from the sides of the tumor, and falling into the channel of the artery. When the cellular coat of the artery begins to yield, the blood of the sac is removed

from the course of the circulation, and the coagulating lymph is deposited in successive layers, so as to prop up the side of the artery, and prevent it yielding rapidly to the force of the heart. Sometimes these coagula are not so firm on the internal surface of the artery. They are liable to be moved by change of posture, or even by the force of the flowing blood. It is probable, that the sudden deaths of those afflicted with aneurism of the aorta, arise from the coagula loosening from the sides of the sac, falling into the channel of the artery and plugging it up.

3d, This disease may kill by compressing the large veins within the chest, and preventing the return of the refluent blood to the heart. When the aneurismal tumor so completely fills the thorax as to destroy the bones, there must be a reciprocal pressure on all the contained parts. In one case of aneurism of the aorta, in a few months, the tumor so filled the chest as to press upon the descending cava, and prevent the return of the blood from the head. The patient had continually a turgid and bloated countenance, with a perpetual sense of suffocation, of which he died not many months from the first complaints.

4th, Aneurism of the aorta sometimes produces death, by pressing upon the trachea, and diminishing its calibre in such a degree as to cause great difficulty of breathing, or by pressing so much upon the œsophagus as not only to pre-

vent food from passing into the stomach, but to cause inflammation and sphacelation of the tube.

5th, The pressure of the aneurismal tumor induces death, by forcing open the chest and rendering the bones carious. An aneurismal artery coming in contact with a bone destroys it. Bones are covered by a membrane by which they are nourished, and when they are deprived of that membrane they quickly die. When the aneurism comes in contact with the bone, it compresses the vessels of the periosteum, the source of nourishment is then cut off, and the bone dies. The same pressure does not destroy cartilage. When we consider the elasticity of cartilage, the state of its vascularity, and the nature of its investing membrane, we shall not be surprised at this circumstance. The bone receives large vessels from its periosteum, is penetrable to injections, and can be made completely red; but cartilage receives lymphatic vessels only, is not penetrable to injections, even in the youngest subject, and is less dependent on the perichondrium than the bone is on its investing membrane. From the little vascularity and great elasticity of cartilage, it must be less exposed to erosion and death from pressure.

6th, A frequent cause of death is the bursting of the aneurism, which is the most awful termination of this disease. The aneurism frequently bursts internally, but sometimes, after destroying the bones, it forms a large external tumor, and

extends the skin to its utmost stretch. The skin loses its elasticity and tone, begins to inflame, then turns of a deeper red, at length becomes more soft and yielding, and a slough forms like the eschar of a caustic. The fluctuation of the contained blood can now be distinctly felt, and as if threatening to burst out. The eschar, which performs the office of a plug, begins to separate, and there is a distillation of a bloody serum; but at last, in consequence of coughing, or some other sudden exertion, the plug gives way, the blood rushes out with violence, and the patient expires in a moment.

7th, Independently of the several ways we have now enumerated, and in which this disease does sooner or later prove fatal, it frequently destroys the patient before any of these accidents can happen. Aware of the dangerous and incurable nature of the disease, and suffering continually from difficulty of breathing, and a sense of suffocation conjoined with sleepless nights and bodily emaciation, he dies slowly, exhausted by harassment of body and mind.

When the aneurism is situated in the arteria innominata, or in the roots of the subclavians or carotids, it is attended with nearly the same symptoms, as when situated in the upper part of the arch of the aorta,—for in this case the tumor generally rises above the sternum, and thus the one aneurism cannot be distinguished to a certainty from the other. The disease also runs the

same course, and has nearly the same terminations when it is situated in the descending thoracic aorta. From being in immediate contact with the spine, and from being bound down by the pleura, it early renders the vertebræ and ribs carious, and forms a beating tumor on the back. In this situation the tumor bursts into the œsophagus, or into the posterior mediastinum, but more commonly into the cavity of the chest.

There seem to be two points of the aortic system peculiarly liable to aneurism,—the top of the arch, and immediately when the aorta has passed through into the abdomen at the root of the cœliac artery. In a lean person, particularly when the stomach is distended with flatus, and after running or walking hurriedly, a pulsation can always be felt in the epigastric region. This is the case when the artery is sound, but when aneurismal, the pulsation is not sensible to the feeling only, but to the sight; and when the tumor is of any magnitude, the pulsation is perceptible from the sternum downwards, and all along the sides of the abdomen, equable, strong, and synchronous with the pulse.

The belly swells, the pulsation grows gradually stronger, and palpitations, difficulty of breathing, restless nights, and extreme pain accompany this disease; and at last, this, like other aneurismal tumors, bursts, and the patient dies. From the situation of the aneurism, it is attended with

some peculiar symptoms, and like aneurism of the thoracic aorta proves fatal in a variety of ways.

1st, Immediately after the aorta has passed betwixt the crura of the diaphragm, it gives off the cœliac artery, which is the place of the enlargement. The diaphragm forms the boundary upwards, so that whenever the tumor is enlarged, this muscle is stretched,—hence the palpitations and difficulty of breathing, which accompany this aneurism, and which is one cause of death. When the aneurism is large, the diaphragm is stretched and forced up in so remarkable a degree, that when the tumor is removed in the dissection, this muscle falls down and appears flaccid.

2d, Attendant on this aneurism, there is dropsy of the abdomen and legs, occasioned by the displacement of the thoracic duct. The thoracic duct passes through the same opening in the diaphragm with the aorta, and is either compressed by the aneurism, or pushed forward and raised upon the tumor, which equally obstructs the passage of the fluid through it. The vena cava abdominalis is also in some degree compressed,—water or a bloody serum is therefore always accumulated in the abdomen.

3d, There occurs early in this aneurism an erosion of the vertebræ. In the arch of the aorta the tumor rises forwards so as to destroy the ribs, clavicles, and sternum; but in the abdomen the artery is braced down by the course of the

diaphragm. It presses upon the upper parts of the lumbar vertebræ, from its very commencement; the ligamentous sheath and periosteum of the vertebræ, are eroded early in the disease,—and thence the bones become carious. In every aneurism there is great pain merely from the distention, which, in the breast, is compared to the points of swords passing in various directions. In the abdomen, there is great pain from the very beginning, then partial lameness, in the progress of the disease complete inability to walk, and at last the patient is confined entirely to bed, being almost paralytic. This paralysis may arise from the mere erosion of the spine, by which the motion of the vertebræ is lost; it may arise from the acrid matter of the carious bone penetrating the vertebral canal, and injuring the spinal marrow; and it may arise from pressure on the lumbar and sacral nerves when the tumor descends very low.

4th, This tumor, like thoracic aneurism, bursts. From its contracting adhesions with the stomach or duodenum, it sometimes bursts into these cavities, but more commonly into the abdomen. From the aorta lying behind the mesentery, and within its folds, when the tumor bursts, the blood instead of being poured out wide into the cavity of the abdomen, passes betwixt the two lamellæ of the mesentery, and is pushed under the outer coat of the intestines; so that when the abdomen is first opened, one might imagine that all

the intestines were in a state of universal gangrene.

Of the internal arteries those that are most subject to aneurism after the aorta are the iliacs. The aneurism generally occurs at the point where they come off from the abdominal aorta, or where they divide into internal and external; but it also sometimes happens in the course of these branches, particularly in the course of the external iliac. Aneurism of these arteries is not so productive of distress, as when it occurs in the thorax or high in the abdomen, but the termination is equally fatal, and this generally arises from bursting.

In the treatment of aortic and other internal aneurisms, we have recourse to the system of depletion, abstinence, and the other remedies recommended under the medical treatment of aneurism, with the view of enabling nature to effect a spontaneous cure.

POPLITEAL ANEURISM.

Aneurism at the bend of the arm, is almost always an accidental, while aneurism of the ham is almost always a spontaneous disease. The popliteal artery seems peculiarly liable to aneurism, which more frequently occurs at this point of the arterial system than in any other external artery, and is generally of that species which is termed

true aneurism. Whether the frequency of popliteal aneurism arises from the artery being hurt in the motions of the joint, as Richerand believes, it is difficult to conjecture; but the disease is so peculiarly frequent, when compared with other external aneurisms, that we are safe in asserting, that popliteal aneurism surpasses in number all others of the lower extremity, in the proportion of ten to one.

The arteries of the lower extremities are not only unsupported, except by loose cellular substance, but have the weight of a high column of blood with a difficult return, and are placed in an extremity of great strength and that is liable to violent and sudden actions. These must greatly endanger the arteries, and if spontaneous aneurism almost never happens in the arm, and often in the thigh, there are no causes to which we can more readily ascribe this circumstance, than those which we have just enumerated.

Of the lower extremities, the most frequent aneurismatic point is the ham, which may be accounted for in two ways. 1*st*, The artery in the ham is very liable to be violently stretched in the free and continual motions of the knee joint; and 2*d*, In the hollow of the ham, the artery is not compressed or supported by firm parts, but lies loose in the cellular substance, which cannot resist or support the vessel in its actions.

The causes of popliteal aneurism may be divided into internal and external,—a division which

will be found to be of great use in practice. *1st*, Whenever an aneurism appears in the popliteal artery, which cannot be ascribed to an accident, there is every reason to believe that it is a constitutional disease. In this case there seldom occurs a single aneurism. It more frequently happens that immediately after the appearance of an aneurism in one ham, the artery in the other ham begins also to be diseased, or a similar tumor appears in the fore part of the thigh, and then a third tumor in the groin: or a tumor makes its appearance in the groin, which gradually increases in size, till at last it bursts, and the patient dies. Upon dissection, several similar tumors are discovered in the course of the artery, within the pelvis, and along the spine, extending to the heart; or perhaps an aneurismal tumor appears first in the ham, then another in the axilla, which bursts and is fatal. As in these circumstances, aneurism is marked as a constitutional disease, the case is so hopeless that it is needless to operate. This species of the disease arising from an internal cause, is therefore an important distinction in practice. *2d*, There is great reason to believe, that the arteries of the thigh are peculiarly liable to aneurism from falls, sprains, and even from spasms, and other violent actions of the muscles. Warner makes mention of one man who had aneurism in a moment, from a violent cramp in the brawn of the leg, and of another who had an aneurism in the ham from a fall or

sprain. Scarpa also relates a case which fell under his observation, in which the aneurism arose from a violent exertion which the patient had made, to relieve himself from a painful cramp of the brawn of the leg of that side; and there are similar cases on record. Popliteal aneurism is proved to proceed frequently from sprains, by immediately succeeding such accidents, by the disease being very rare in women, and of frequent occurrence in men, particularly in post boys, porters, and others in the lower ranks of life, who are not only exposed to blows and sprains, but to every kind of hard labour. *3d*, There is another cause of aneurism of the lower extremity, of the same nature as that arising from wounding an artery in venesection, as is exemplified in wounds from penknives, scissars, and other sharp pointed instruments.

Popliteal aneurism may be ascribed to an internal and external cause, and there are three states in which it presents itself, all imputable to these causes :—1*st*, The spontaneous disease, or that arising from an internal cause, and which admits of no cure. *2d*, That which arises from an external cause, as blows, sprains, or cramps. This condition of the disease is more favourable, and the operation should be performed, although the surgeon cannot promise success,—because the manner in which it is produced indicates a predisposition to disease in the arterial system.—And *3d*, The false aneurism, or those few cases aris-

ing from wounds, the only ones in which the result of an operation is certain and successful.

In the commencement of popliteal aneurism, the tumor is small and round, it has a distinct pulsation, is situated fairly in the middle of the hollow betwixt the hamstring muscles, there is no change of colour in the skin, and little pain either in the site of the disease or down the leg. But the tumor increases with a rapidity proportioned to the exercise of the limb, and soon fills up the hollow of the ham; the sciatic nerve, consisting of two branches, is stretched upon the tumor, producing great pain, with a cramped state of the limb, attended by numbness; and from the pressure on the veins and lymphatics, the leg and foot swells. In the progress of the disease, the tumor becomes hard, and has a strong pulsation; as the disease advances, the cavity of the ham becomes so much distended that there is great and continual pain; the pulsation now becomes obscure, and at last ceases; the circulation in the limb is obstructed; there is coldness of the extremity, with loss of feeling and complete lameness; from the pressure of the tumor, the bones become carious, and the structure of the knee joint is irretrievably destroyed.

From the fatal effects which always attend the long continuance of the disease, the operation should be performed as early as the existence of the aneurism is ascertained, or as soon as the patient applies for surgical advice. The advantages

which have been expected to result from delay, by giving time to the anastomosing branches to enlarge, has introduced a very hurtful practice. The confusion of parts and the destruction of structure which follow the long continuance of the disease, show the necessity of an early operation, while it is now well ascertained that the channels of communication through the anastomosing branches, are always so free as to maintain the circulation in the limb when the main artery is tied.

OPERATION FOR POPLITEAL ANEURISM.

For the reasons we have adduced under the surgical treatment of aneurism, surgeons have abandoned the old operation of opening the sac and tying the artery in the ham. The new operation by taking up the artery at a higher point on the fore part of the thigh is universally preferred by the surgeons of this country. The artery may be tied any where below the origin of the profunda, although it is more accessible at some points than others; besides, independently of this circumstance, there are other reasons which lead us to prefer the taking up the artery in a fixed situation, or making a point of election, such as at a proper distance from the seat of the disease, where the vessel is superficial, and sufficiently remote from the origin of the profunda,

so as to lessen the danger of consecutive hemorrhage upon the separation of the ligature.

The profunda comes off from the femoral artery an inch and a half or sometimes two inches below Poupart's ligament, which last distance it never exceeds; and the preferable point at which to tie the artery is from an inch and a half to two inches below the origin of the profunda. In this situation, the artery is quite superficial, and far enough from the branching of the vessel to prevent the risk of hemorrhage. In conducting the operation, the patient should be laid in the horizontal posture upon a bed or a table, a tourniquet may be placed about the limb immediately below the groin in case of accident, but left unscrewed, as the artery is easier discovered when beating than when empty. If the patient is lean, the course of the sartorius muscle will be easily discovered by turning the knee in, and the artery will be felt at the upper part of the thigh beating nearly along its inner edge. When the patient is fat or the thigh œdematous, so that the course of the sartorius cannot be seen, or the beating of the artery discovered, the situation of the vessel may be always ascertained by measurement. While the patient is reclining on his back with his toes pointing upwards, let the foot of the limb to be operated on be turned so far out as to form with the opposite foot a right angle, and let a straight line be drawn from the angle of the pubis to the anterior superior spinous process of the ilium. The

centre of this line will show the situation of the external iliac, and if another straight line be drawn from this point down the middle of the thigh, it will indicate the course of the artery with such accuracy as to cause little difficulty in finding it in operation. When the situation of the artery has been ascertained, and the knee turned out to make the skin tense, an incision should be commenced about two inches below Poupart's ligament, and prolonged for three inches in the course of the artery. This incision should be carried through the skin and cellular substance down to the fascia lata. From the centre of this incision the fascia must be cautiously opened for half an inch upwards, and to the same extent downwards, when the artery will be found involved in its cellular sheath along with the femoral vein and saphena nerve, an important branch of the anterior crural. At this point the vein lies in close contact with the artery on its inner side, or rather a little behind it, and the nerve is situated on its outer side, or rather on its anterior surface. If the sartorius muscle, at the inner edge of which the artery is situated, should interfere with the dissection, the assistant must hold it aside by means of the curved spatula represented in the annexed drawing*. This instrument should be used by the assistant in preference to his finger throughout the whole operation. In cutting for

* See next page.

an artery, or performing any other delicate piece of dissection, the curved spatula is decidedly preferable to the finger, as it does not interfere with the knife, or obstruct the operator's view of the parts he is dissecting. By scratching with the point of the knife and raising the cellular substance with the dissecting forceps, the artery will be easily detached from its surrounding connections; but the vessel should on no account be raised from its bed, nor separated from the vein and nerve, to any farther extent than is just sufficient to permit the ligature to be passed by means of a bent eyed probe, or the aneurismal needle represented in the marginal plate.

Curved Steel Spatula.

Aneurismal Needle.

When the ligature is passed, it should be tied with a single knot, pulled moderately firm, and

then farther secured by another single knot. The wound is then to be sponged so as to clear it of blood, the lips are to be brought together and secured by adhesive plaster and the uniting bandage, while the ends of the ligature are left hanging from the wound. To repress any pulsation which might continue in the tumor, when the artery is tied far from the seat of the disease, a couple of compresses are to be placed in the ham, and a flannel roller applied with some degree of tightness all along the limb, beginning at the toes and ending at the top of the thigh. The tourniquet must be left loose round the upper part of the limb, and pupils must be appointed to watch in case of accidents. By adhering to these directions, the artery will be tied from an inch and a half to two inches below the going off of the profunda, and just at the place [illegible] the artery begins to come in contact [illegible] the sartorius muscle. [illegible] this situation [illegible] vessel lies [illegible] exposed as not to embarrass the operator.

As soon as the ligature is tied, the pulsation ceases in the tumor, which loses its tension and becomes soft and visibly smaller. The limb sinks in temperature, feels colder than the other, and no pulsation can be felt in the anterior tibial artery on the [illegible] the foot. This change how[illegible] is of short duration, for in twenty-four hours, and sometimes in a shorter period, the heat, feeling, and pulsation generally return. An increased arterial action then succeeds, produc-

tive of an augmentation of heat, and the limb is found to be several degrees higher than the sound one. This increase of temperature continues for a few days, when it gradually sinks to the healthy standard. The tumor in the ham slowly diminishes, and the limb by degrees regains its former strength.

When the femoral artery is tied below the origin of the profunda, the circulation is continued in the limb chiefly by the perforating arteries of the thigh, namely, the branches of the profunda, inosculating with the articular arteries of the knee,—although all the smaller arteries enlarge and essentially contribute to this office. It is worthy of remark, that at whatever point it is tied, if there are no considerable branches given off betwixt the ligature and profunda, the femoral artery is uniformly obliterated up to the origin of that vessel; but if any considerable branches arise from the trunk, betwixt these two points, this is not the case and these branches dilate and assist in carrying on the circulation. This disposition of the smaller arteries of a limb to dilate, when the main artery has been tied or otherwise obliterated, has been beautifully illustrated by the injection and dissection of aneurismal limbs, which had been operated on several years previous to the patient's death. In these preparations, all the smaller arteries are not only considerably enlarged, but very tortuous.

From the number and enlarged size of the ar-

teries of a thigh, which has been operated upon for aneurism, it is evident that if we should, at a future period, be forced to amputate the limb, the operation would be attended with great risk, from the numerous arteries requiring to be secured by ligature; and if the patient were much debilitated or far advanced in life, he might lose so much blood as not to recover from the operation.

INGUINAL ANEURISM.

The whole course of the femoral artery, from the groin to the point where it perforates the triceps muscle, is subject to aneurism, and from the exposed situation of the vessel, the aneurism more frequently arises from wounds than from any other cause. It is therefore generally of that species called false, which is the most favourable for operation. But although this is often the case, it is not always so, as the aneurism frequently occurs spontaneously. When the disease is situated in the groin or upper part of the thigh, the tumor remains long circumscribed, and increases in size very slowly. This arises from the firmness of the cellular substance surrounding the artery, and from the thick and dense state of the fascia binding down the tumor and resisting its increase.

We have long been assured of the sufficiency of the profunda to maintain the circulation in the limb, when the femoral artery has been obliterat-

ed; but it is only of late years, that surgeons have had any confidence in the powers of the anastomosing branches to carry on the circulation when the artery has been tied above the origin of the profunda. Mr. John Bell, reasoning from anatomy, and from the cases recorded by Guattani*, first called the attention of the profession to this subject, and maintained "that we should tie the arteries as boldly at the groin, or in the axilla, as in the lesser branches going down the thigh or arm."† He conceived that the anastomoses betwixt the branches of the internal iliac and profunda, were so free as to be quite adequate to carry on this circulation, when the external iliac artery was tied. Mr Bell's reasoning has led to most important improvements in practice. In 1796, Mr Abernethy ventured to tie the external iliac artery, and although the two patients on whom he first operated both died, still the cases shewed that the circulation was freely carried on in the limb. He afterwards tied this artery in other two cases, with success, and the operation has since been performed successfully by Mr. A. Cooper, and many other surgeons. The external iliac artery has been tied for the cure of aneurism in twenty-seven cases, which have come to my knowledge, and in twenty of these the pa-

* See Guattani De Externis Aneurismatibus.

† Discourses on the nature and cure of wounds by John Bell, 1795.

tients have recovered. From this statement, it appears, that we are now entitled to place the ligature of the external iliac artery amongst the regular operations of surgery.

OPERATION FOR INGUINAL ANEURISM.

In tying the external iliac artery, the patient must be placed in a reclining posture upon a bed, a table, or a sofa, and the situation of the artery immediately above Poupart's ligament must be ascertained by the pulsation, or in the absence of this mark, by the measurement already laid down in the directions for performing the operation for popliteal aneurism. When the position of the artery is ascertained, an incision four inches in length, in the direction of the vessel, but a little exterior to it, is to be carried through the skin and cellular substance, on the anterior part of the abdomen. This incision should not be carried quite down to Poupart's ligament, but should terminate about half-an-inch above it. The aponeurosis of the external oblique muscle will now be brought into view, and is to be divided to the same extent, which will enable the surgeon to pass his finger under the lower edge of the internal oblique and transverse muscles, betwixt them and the peritoneum. By carrying along his finger a probe-pointed bistory, these muscles are to be divided upwards. When this has been effected, the finger is to be passed

behind the peritoneum, which is easily separated from the subjacent parts. The artery will then be felt beating distinctly at the inner edge of the psoas muscle, with the vein situated on its inner side, the nerve on the outer side, and having the psoas muscle interposed betwixt it and the artery. The artery is to be carefully separated from the vein to a small extent, by tearing with the finger the cellular substance which connects them, and the ligature will then be passed by the aneurismal needle with the utmost ease. The ligature should be tied with a single knot, and farther secured by another single knot; the lips of the wound are then to be brought together and retained by adhesive plaster or suture; and the patient's body and leg to be placed in such a position as most effectually to relax the artery. When the femoral artery is tied or obliterated above the origin of the profunda, the circulation is carried on by the inosculation betwixt the circumflex branches of this vessel, and the branches of the internal iliac. These branches are the gluteal, internal pudic, obturator, and ischiatic arteries, all contributing to this office, but the obturator and ischiatic being more immediately concerned in it.

CAROTID ANEURISM.

Aneurism of the carotid artery generally occurs at its division near the angle of the jaw.

Sometimes the aneurism is situated in the external carotid, sometimes in the internal, and sometimes in the common trunk. The disease may either arise spontaneously, thus forming what has been called true aneurism, or occur in consequence of a wound. When it happens in consequence of a wound, the aneurism, like that in the bend of the arm arising from bloodletting, is always circumscribed, because the sheath in which the artery is contained, prevents the diffusion of the blood, giving the tumor a circumscribed form. The disease is in general rapid in its progress, and soon proves fatal by producing suffocation. From the pressure of the tumor upon the larynx and pharynx, the disease is always attended more or less by a tickling cough, difficulty of breathing and swallowing. In one case which I saw, the tumor increased so rapidly, as to attain the size of a goose's egg in six weeks from its first commencement. It was attended not only with difficulty of breathing, and violent cough, but with considerable stupor, and so great difficulty in swallowing, that the patient who was a young woman died in six weeks, from the first appearance of the disease; she was literally starved to death. This case occurred twenty-five years ago, when no operation for aneurism of the carotid artery had hitherto been performed. The cutting off so great and so direct a supply of blood from the brain, it was imagined, would soon prove fatal by deranging the functions of that organ.

Independently of this circumstance, when we consider the vicinity of the carotid artery to the heart, —the impetus of the heart acting upon it,—the great size of the artery, and the loose cellular substance in which it is imbedded, it is natural to suppose, that there would be great danger of the artery either bursting or ulcerating. Still we are not entitled to oppose theory to fact. Cases had been recorded by Haller, Petit, and others, which proved that the carotid artery might be obliterated without diminishing the energy, or otherwise deranging the functions of the brain, and this vessel has now been tied twelve times to my knowledge. The death of some of the patients did not necessarily follow from tying the artery; as they did not die from cutting off the supply of blood to the brain, or from the bursting or ulceration of the artery, but from concomitant circumstances from which no operation is exempt. It is only from the records of former cases that we can deduce rules of practice, and these cases testify that the carotid artery may be tied as successfully, and with as great ease, as any of the large arteries of the extremities. Indeed, the tying of the carotid artery has not only been performed with success, but the operation has been fully more successful than that on the larger arteries of the extremities. This seems to arise from the common carotid giving off no branches in its whole course along the neck, which circumstance favours the formation of coagulum,

and insures the adhesion of the artery upon the application of a ligature. In one of the cases I attended where the artery was tied by Mr. John Bell, there was not above two tea spoonfulls of blood lost during the whole operation, and it actually did not run down so as to soil the handkerchief round the patient's breast. The case is detailed in Mr. Hodgson's treatise on the diseases of the arteries and veins.

OPERATION FOR CAROTID ANEURISM.

From the effects which aneurism of the carotid artery early manifests upon the larynx and pharynx, the operation should be performed as soon as the nature of the disease is ascertained, or the patient comes under the surgeon's care. This direction is the more imperative, as the question about the collateral arteries having time to enlarge cannot apply in this instance,—the communication betwixt the arteries of the brain being free and direct.

The exact point at which the artery should be tied, must depend upon the situation and size of the aneurism; but the aneurism is in general situated so high, and lies so fairly under the angle of the jaw, that the preferable point for tying the artery is o[illegible] to the space between the thyroid [illegible]es. At this place the artery is [illegible]al, and more free of [illegible]

connections than elsewhere. In tying the carotid artery, the patient should be placed in a chair, with his head turned a little to the side to be operated on, and reclining back upon the breast of an assistant. The external incision should then be begun immediately below the tumor, and carried downwards to the extent of three inches in the direction of the inner edge of the mastoid muscle, which is to be raised to a small extent by the finger of the operator, or the handle of the scalpel, and then held back by an assistant with a curved spatula. The surgeon now dissects for the sheath of the artery, by slight scratches with the point of the scalpel, close by the trachea. When the sheath is distinctly brought into view, he opens it at its inner edge, by laying hold of it with a pair of dissecting forceps and cutting horizontally. The assistant then, by means of the curved spatula, holds back the par vagum and internal jugular vein, while the surgeon passes the ligature by an eyed probe bent, or the aneurismal needle, carried from without and brought out by the side of the trachea. If the mastoid muscle has not been raised to any great extent in the operation, and the artery dissected for close by the trachea, the internal jugular vein will not be brought into view. This is the more desirable, as the swelling of the vein is apt to conceal the artery, and in dissecting for it is in danger of being cut; but should it appear, an assistant must compress it in the upper part of the wound, which, by obstructing the flow

of blood in it, will render it flaccid, so as not to incommode the operator in dissecting for the artery, or in passing the ligature. If the artery is dissected for at the point we have recommended, the only parts seen in the dissection will be the mastoid muscle, par vagum, and artery, with the omohyoideus crossing the sheath of the vessels in the lower angle of the wound,—unless it be sometimes the nervus descendens noni running along that sheath. After the artery has been tied, the ligature is to be brought out of the wound, the edges of which are to be placed in contact, and retained by means of black court or adhesive plaster; and a roller should be passed round the head and brought down by the sides of the chin over the breast, then carried under the armpits, and over the shoulders, so as to keep the head down, and thus relax the artery.

AXILLARY ANEURISM.

Aneurism is peculiarly apt to occur in those arteries which are situated in the neighbourhood of large joints, especially if there is any predisposition to disease in the artery. The overstrained motions of the joint, with a tendency to disease in the artery, endangers the production of aneurism, and hence its occurrence is very frequent in the ham, and by no means rare in the axilla. When an aneurism is situated in the axilla, from

the looseness of the cellular substance and fascia, the tumor increases rapidly. It soon fills up the hollow of the axilla, forces up the clavicle, and by its distention inflames the integuments and endangers bursting. This aneurism above all others, should therefore be operated on early. We have the most direct evidence, that when the main artery is obliterated, the anastomosing branches here, as in all other situations, are fully adequate to carry on the circulation. This is proved by the spontaneous cure of several cases of axillary aneurism, where the artery had been found obliterated upon dissection; by several cases on record, where the subclavian artery has been found after death, converted into a ligamentous cord, notwithstanding which, there has been no deficiency of circulation in the limb; and by the success, which, in several instances, has followed the operation of tying this artery in aneurism. Indeed, the question about the power of the anastomosing arteries to carry on the circulation, in every situation when the main artery is obstructed, I hold to be now completely at rest, as there is abundance of proof to the point. Even when the course of the blood has been obstructed in the aorta, the circulation has been carried on by means of anastomosing branches.

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* See a case by M. Paris, related in the first volume of Desault's Chirurgical Journal, where the descending aorta was

OPERATION FOR AXILLARY ANEURISM.

Two operations have been proposed for axillary aneurism. The first of these is to tie the artery below the clavicle, and the second to take up the vessel above it. The objections to the operation below the clavicle are great. It is impossible to tie the artery below the clavicle, without cutting pretty extensively one or both of the pectoral muscles, and at the same time incurring the risk of wounding the axillary vein, which lies directly before the artery. The cephalic vein, also, where it enters the axillary, is liable to be cut, as are the thoracic arteries where they come off from the axillary, besides either dividing one or more nerves of the brachial plexus which surround the artery, or including them in the ligature. These objections seem to me to be so insuperable, that in every instance, whether the aneurism were situated high or low in the axilla, I should prefer tying the artery above the clavicle,—the vessel in that situation being got at both more easily and safely.

The subclavian artery has been several times tied for axillary aneurism, but as far as I know

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considerably contracted: and another case in the 2d part of Mr. A. Cooper's Surgical Essays, where the patient lived 40 hours after a ligature had been put round the aorta.

only three times with success, viz. once by Dr. Post of New York, once by Dupuytren of the Hotel Dieu, and once by Mr. Liston of Edinburgh; but even in those cases in which the patients died, the operation was so far successful, as to shew, that the anastomosing branches were quite adequate to continue the circulation in the limb, when the main artery was tied.

In taking up the subclavian artery, a chief obstacle experienced in the operation, has been the difficulty of passing the ligature round the artery, from its depth, and from the smallness of the cavity in which it is contained. This has especially occurred in those cases where the acromial end of the clavicle has been much raised by the pulsation of the aneurism; and in one instance, the difficulty was so great as even to force the surgeon to abandon the operation after its commencement. It has also sometimes happened, that the surgeon, deceived by the artery communicating its pulsation to the nerves, with which it is immediately in contact, has missed the vessel altogether, and in its stead has included in his ligature one of the cords of nerves. The difficulty of passing the ligature, and the danger of missing the vessel, may be obviated by position and by measurement. When these are attended to, this operation will be found as safe and as easy, as any of the other operations for aneurism.

Previous to the commencement of the operation, the patient should be placed on a low couch

in a sitting posture, so that his body and lower limbs may form an obtuse angle, while his head is bent backward so as to form, with the back part of the trunk, another obtuse angle. The head of the patient is now to be turned to the side opposite to that which is to be operated on; the arm is to be held close by the side; an assistant is forcibly to push down the shoulder, and at the same time to bring it as far forward towards the breast as he is able. The subclavian artery, along with the vein and cervical nerves, which go to form the brachial plexus, lie in a cavity of the form of an isosceles triangle, one side of which is formed by the clavicle, the other side by the omohyoideus, and the base by the outer edge of the clavicular portion of the sterno-mastoideus muscle. If the position here recommended be attended to, this cavity will be so far enlarged, and the artery rendered so superficial, that in the dead body where there is no disease, the ligature can be easily passed round the artery, by means of the common aneurismal needle, or a bent probe. In axillary aneurism, where the disease has not been of long standing, so that the clavicle is not displaced, this may be done by Deschamp's needle; and even in those cases where there is considerable elevation of the bone, and consequently the artery is deep, by Mr. Watt's needle represented in the marginal plate*.

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* See page 400.

To ascertain the situation of the artery, while the patient is in the position we have now recommended, a line is to be drawn above the clavicle from its sternal to its acromial end. The clavicle being of a curved form, will represent a bow, and this line the string of the bow. This line must now be divided into seven equal parts, and three of these parts from the sternal end, and four from the acromial, will mark the exact point at which the artery will be found. So correctly does this measurement indicate the situation of the artery, that if a fine pointed instrument be held at right angles to the clavicle, and pushed downwards and inwards, at the distance of one part and one fourth from this bone, it will pass through the artery*. The external incision should be about three inches and a half in length, commencing about half an inch from the sternal end of the clavicle, and carried along the line of measurement towards the shoulder, taking care that the point which we have marked should form the centre of the incision. Any branches of the external jugular vein, or any other vessel which may happen to be cut, should now be secured by ligature, so as not to embarrass the surgeon in the subsequent steps of the operation. Although the external incision passes over the clavicular por-

* For this highly important measurement, I am indebted to Mr. Walker, late Lecturer on Anatomy and Physiology in Edinburgh.

tion of the mastoid muscle, and the trapezius muscle, it should be carried only through the skin and fibres of the platysma myoides. The clavicular portion of the mastoid muscle especially should not be cut, as its outer edge is a good guide to find the artery. As soon as this incision is accomplished, the knife should be employed as little as possible, and the artery should be searched for by the finger. The subclavian artery, vein, and nerves, are not included in the same capsule, but are connected only by cellular substance,—so that the vessel can be easily found and separated by the finger. There is danger of using the knife, from the proximity of the internal jugular vein, and from numerous other veins, together with a considerable twig of the brachial nerve, all which lie in the way of the operator. By carrying the finger to the bottom of the incision, down by the outer edge of the clavicular portion of the mastoid muscle, the operator will feel the tubercle of the first rib into which the scalenus primus is inserted, and immediately exterior to this muscle, he will find the artery. At this place the artery is not only readily found, but this point is the most distant from the large nerves and from the branches which the vessel in its course sends off. The ligature must now be passed by means of the common aneurismal, Deschamp's, or Mr. Watt's needle, according to the depth of the artery. A noose is to be cast upon the ligature, which the surgeon will be enabled to

draw so tight as to embrace the vessel firmly, by passing the ends of the ligature through the *serre nœud* delineated in the marginal plate.

EXPLANATION OF THE PLATE.

Fig. 1st. Deschamp's needle, which is the instrument employed by the French surgeons for passing a ligature round an artery.

Fig. 2d. Mr. Watt's needle. This instrument consists of a flat silver canula, with a curve at its extremity. The canula is five inches in length, and contains a flat piece of steel as large as the tube itself. To its upper part are attached two rings, and on the lower parts at the back, is an opening two inches long to allow the free passage of the ligature. The

A second knot is to be formed in the same manner, and then the integuments are to be brought together, and secured as in the other operations for aneurism.

When there is not room to tie the subclavian artery on the external side of the scalenus, it has been proposed to tie it on the tracheal side. Any one [illegible] the anatomy of the parts, will at once be convinced of the impracticability of such an operation. There is no artery of the body so connected with important nerves and blood-ves-

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needle which is somewhat thicker than a common watch spring, and of a greater degree of curvature than the cannula, may be made of silver or any other metal.

Fig. 3. A Serre Nœud. This instrument is just a curved pair of forceps with rounded points, and small holes running obliquely from the points to the sides of the blades. After the noose is cast upon the ligature, its ends are passed through the holes, and by carrying the points of the forceps down upon the artery, a knot is formed which can be tightened as much as is judged necessary, by separating the handles of the instrument. The blades are short and the handles long, which, by increasing the purchase, gives the surgeon a greater command over the knot.

Mr. Liston used an instrument similar to this in tying the subclavian artery, and which is delineated in the 64th Number of the Edinburgh Medical and Surgical Journal. This instrument suggested to me the idea of the one which is here represented, and which differs from Mr. Liston's only in one point, namely, that his instrument tightens the ligature by its elasticity or spring, while the curved forceps draws the knot by the separation of its handles, and thus enables the surgeon to ascertain the force he exerts on the artery.

sels, as the subclavian at this point, and it will be found almost impossible to pass a ligature without wounding one or more of these parts. I therefore cannot help thinking, that when the aneurism is situated so high in the subclavian, as not to leave room to tie the artery on the outer side of the scalenus muscle, it is not a case for operation.

BRACHIAL ANEURISM.

Brachial aneurism is most frequently situated in that portion of the artery which corresponds with the flexure of the forearm, and is generally produced by external injury. It therefore belongs to that species of the disease denominated false aneurism, and in ninety-nine out of an hundred times arises from the artery being wounded in venesection. All the symptoms which have been enumerated under the head of false aneurism present themselves, and are well marked, in this form of the disease. From the wounded artery being covered by the strong tendinous expansion of the biceps muscle, the aneurism is always circumscribed; if the arm is not much exerted, it remains long stationary; but upon any great exertion, the aneurism suddenly increases in size, so that frequently when the tumor has been no larger than a small chesnut, it has, upon a violent motion of the arm, immedi-

ately enlarged to three or four times the size. In proportion as the tumor enlarges, and the tendinous expansion of the biceps is stretched, the forearm bends and the fingers become curved. The disease is then attended with great pain, and the limb is cold and almost useless.

It is commonly imagined, that the danger of the aneurism bursting, and the immediate death from hemorrhage, are the chief motives for performing an operation, but this is a great mistake. The effused blood is surrounded by condensed cellular substance, by the fascia, which in this situation is particularly strong, and by the skin, all of which prevent the bursting of the aneurism; besides, the inner surface of the sac is so lined by layers of coagulated lymph, as to render it almost impenetrable by the force of the artery. The coagula every day acquire additional strength from the deposition of new layers, and as the tumor increases in size, the artery must become more and more depressed from the extravasated blood, till it is pressed against the bone. The arm is then deprived of blood, it becomes feeble, and the pain is so great as to force us to operate.

It is therefore the general compression, the weakness and pain that call for operation, and not the danger of bursting; and as brachial aneurism most frequently occurs in the lower ranks of life, the disease is so much accelerated from labour, that in a short time the patient is unable to

use the arm, or to bear the pain and numbness,—he is therefore forced to apply for surgical assistance. To remedy these evils, the surgeon has recourse to an operation, although not impelled by any immediate danger. Indeed, there is every reason to believe, that when the pulse becomes feeble, and the hand cold, the disease is about to undergo a spontaneous cure. The artery being now compressed by the size and firmness of the tumor, the blood is consequently obstructed in it, and must seek a new route. The inosculating branches will enlarge, the circulation be re-established, and the tumor itself absorbed in the course of time. If brachial aneurism were left to run its natural course, I am convinced, that in 19 cases out of 20, this would be its termination, and that a spontaneous cure would be effected.

OPERATION FOR BRACHIAL ANEURISM.

For the reasons adduced under the surgical treatment of aneurism, we abandon the operation of opening the sac, but take up the artery two or three inches above its wounded point. The artery can be felt pulsating all along the arm, at the inner edge of the biceps muscle, and it can be easily included in a ligature with very little loss of blood. The patient and surgeon being seated, a band or ribbon should be passed round the arm a few inches above the elbow, to ascertain the

place of the subcutaneous veins, so that they may be avoided in the operation. As soon as their situation is ascertained, the band is to be removed, and an incision to be made three inches in length through the skin and cellular substance, at the inner edge of the biceps muscle, in the course of the artery, beginning five inches above, and carrying it down to within two inches of the tumor. The fascia encircling the arm is now brought into view, and is to be divided in the same direction as the external wound, to the extent of two inches, when the cellular sheath, including the artery, veins and radial nerve, will be immediately discovered at the inner edge of the biceps muscle. The muscle is to be held aside by the curved spatula and the sheath to be cautiously opened, by means of the dissecting forceps and scalpel, upon that side of the artery which is next the biceps, in order to avoid cutting any of its branches, all of which are sent off from its inner edge. When the capsular sheath is opened, and the artery a little dissected, the nerve will be found upon its inner side, and the artery itself lying betwixt its accompanying veins. The ligature may be passed by means of the aneurismal hook, or an eyed probe; and in order to avoid including the nerve, the instrument should always be carried from the inner, towards the outer part of the arm,—or this accident may be prevented by raising the nerve on a probe. The ligature is now to be tied, the edges of the wound

must be brought together, and retained by adhesive or black court-plaster, with bandage, and the forearm is to be gently bent.

SECTION II.

ACCIDENTS OF THE ARTERIES.

In no part of the animal body are injuries more certainly attended with fatal effects than in the arteries, and there is no point of practice about which the surgeon's mind should be more completely made up. He may in a moment be called to a case, where the life of the patient will entirely depend on his knowledge and promptitude of action. There is, therefore, no department of his profession, with which the surgeon should be more intimately acquainted, than with the accidents of this structure. The chief of these are wounds.

WOUNDS OF THE ARTERIES.

We have said that the most common accident to which an artery is liable, is a wound, and in this case the great danger to be apprehended is hemorrhage. If the wound in the artery has a direct communication with an external wound,

and if it has been inflicted with a sharp instrument, hemorrhage invariably follows, and is proportioned in violence to the size of the wound and vessel, as well as to its proximity to a large trunk. But if the wound is the result of laceration, bleeding seldom succeeds, even where the vessel is large,—thus limbs have been torn by machinery, or carried off by a large shot, without the accident being followed by hemorrhage.

When an artery is wounded through the integuments, and the communication with the external wound is direct, the blood, which is of a bright vermilion colour, is thrown out in jerks with a force proportioned to the size of the artery. If the artery is large, the blood is quickly evacuated, and the resistance to the action of the heart being suddenly removed the patient immediately dies. This arises not from the quantity of blood lost, but from the rapidity with which it is discharged. Hence, when a large vessel is wounded, or when, from the direction of the wound, there is reason to suspect that this is the case, if the hemorrhagy has been stopped and the wound bound up, it should on no account be undone for examination, without previously placing a tourniquet round the limb,—as without this precaution, such a hemorrhagy might take place as would prove instantly fatal. If the artery has been wounded by a spicula of bone, and there is no external wound, the blood slowly escapes into the adjoining cellular substance, forming false

aneurism; and if there is an oblique communication betwixt a wounded artery and the surface, the same consequences generally follow,—more especially if the wound in the artery is small or what is called punctured. The blood in this case does not escape at the external wound, but is slowly effused into the sheath of the artery forming aneurism. This I have known to happen even in so large an artery as the carotid, where it had been wounded by a penknife.

When an artery is divided, it both retracts within its sheath, and contracts in its diameter to a certain degree; and if the artery is not large, and the impulse of the circulation not great, a clot is formed which puts a temporary stop to the hemorrhage. The formation of this clot is promoted by the retraction and contraction of the artery, as well as by whatever lessens the force of the circulation. Hence fainting, by diminishing the vascular action, essentially contributes to promote that process by which hemorrhagy is spontaneously suppressed. When blood escapes from a large vessel, it is quickly evacuated, in this case no clot is formed, and the patient dies. When it comes from a small vessel, he at length faints, a clot is then formed, and he is saved. Fainting therefore so manifestly tends to save the life of the patient, that in every case of a wounded artery to which a surgeon is called, he should be careful to secure the bleeding vessel before he attempts to rouse the patient from his faint,—other-

wise the hemorrhage may be renewed, and the patient die.

It had long been observed, that, in certain circumstances, the bleeding from divided arteries, especially when the vessels were not of great magnitude, ceased spontaneously; but it was not till early in the last century, that surgeons began scientifically to enquire into the causes to which the natural stoppage of hemorrhage was to be ascribed. Petit, about 100 years ago, was the first who instituted a course of experiments upon living animals to determine this point, and the result of these, along with observations made on the human body, are contained in three essays, which are to be found in the memoirs of the Royal Academy of Sciences for 1731, 1732, and 1735. Observing that a clot of blood was generally found in the extremity of a divided artery, whether the hemorrhage ceased spontaneously, or was stopped by art, Petit maintained, that the cessation of hemorrhage arose from a coagulum which plugged up the mouth of the artery, that it was situated partly within and partly without the vessel, and effected the accomplishment of its object, by afterwards adhering to the inside of the vessel and to its external orifice. He believed that the form of the clot in a great measure arose from the manner in which the hemorrhage was stopped, and his doctrine led him to give the preference to compression over the ligature, as forming a firmer and better clot.

Morand, the confrere of Petit, in his memoir in the Royal Academy of Sciences for 1736, agrees with him, that a coagulum contributes to the stoppage of hemorrhage, but asserts, that this end is chiefly effected by the change which takes place in the artery. He describes the artery as lessened in diameter by the corrugation or crisping up of its fibres, and believes that the form of the clot is modified by this change.

Mr. Sharp, in the introduction to his surgery in 1739, states, that "the blood-vessels immediately upon their division, bleed freely, and continue bleeding till they are either stopped by art, or at length contracting and withdrawing themselves into the wound, their extremities are shut up by the coagulated blood;" thus combining the doctrine of the natural cessation of hemorrhage, being attributable to the contraction and retraction of the artery, with that of the formation of a clot,—a theory which has since been fully confirmed and explained by the scientific experiments of Dr. Jones*.

Pouteau, in his *Melange de Chirurgie*, published in 1760, denied the retraction of the artery, as it had never been demonstrated; and as he observed the coagulum frequently awanting, he asserted, that neither the retraction of the vessel, nor the coagulum, was the chief instrument employed by nature in the stoppage of hemorrhage,

* See Jones on Hemorrhage.

but contended that the tumefaction of the cellular substance, in the immediate vicinity of the wounded artery, formed the chief barrier to the continuance of the hemorrhage. Although Pouteau's theory was erroneous, his doctrine led to a sure practice, viz. the adoption of the ligature, which he conceived to be useful, chiefly by inducing a thickening of the surrounding cellular substance.

Gooch, Kirkland, White, Aiken, and some other English surgeons imagined, that the natural cause of the suppression of hemorrhage depended on the artery contracting in its diameter.

Mr. John Bell strenuously opposes all the preceding doctrines, and asserts that the chief cause of the natural cessation of hemorrhage is the circumstance of the surrounding cellular substance being injected with blood, and thus compressing the wounded vessel.

Lastly, Dr. Jones instituted a series of experiments, to determine the process employed by nature in suppressing the hemorrhage from divided arteries. These experiments clearly shew, that the authors we have now quoted, have taken only partial and circumscribed views of the subject, and that their theories are erroneous, in as much as they ascribe to one cause, that which is the result of a combination of causes. The experiments of Dr. Jones prove, that the retraction and contraction of the artery, with the formation of a clot, are the means by which nature puts a tem-

porary stop to the hemorrhage, and that the effusion of coagulating lymph and consequent obliteration of the vessel, are the subsequent steps of the process by which it is permanently stopped. Whatever surgical means are most effectual in accomplishing these ends, are the best calculated to stop the hemorrhage. The ligature, for reasons which have been already adduced, is the preferable mode of practice, and it should always be applied as near to the wound in the artery as possible,—because in that case, the anastomosing branches are prevented from bringing the blood into the channel, in the vicinity of the wound, and thus renewing the hemorrhage.

Having thus briefly stated the nature of wounded arteries, the doctrines entertained with regard to the spontaneous suppression of hemorrhage, and the cause of the permanent closure of the vessel, I must refer the reader for the practice to be followed, to the introductory part of the chapter on wounds, in volume first.

SECTION III.

DISEASES OF THE VEINS.

THE result both of operation and disease has demonstrated, that, when the flow of blood is obstructed in the main artery, the collateral bran-

ches immediately enlarge and maintain the circulation. The same freedom of communication, and the same tendency to dilate exist in the veins as in the arteries. There are two sets of vessels belonging to this system, the one superficial, and the other deep seated; and the communication betwixt them is so free in the extremities, that, when the flow of blood is prevented in the deep seated veins by the action of the muscles, the superficial convey the full proportion. The veins are much more frequently obliterated than the arteries, but, from the readiness with which their collateral branches enlarge, there is no obstruction to the circulation. It is by no means uncommon to find upon the dissection of those who have died of aneurism, that the tumor by its pressure, has annihilated the corresponding vein; and there are several dissections on record where the ascending vena cava has been found obliterated to a considerable extent, without the existence of dropsy or any other apparent disease. The obliteration of veins seems to be a necessary consequence of the long continued pressure of tumors. When the female breast becomes scirrhous, the internal veins are obliterated, and the subcutaneous ones become enlarged. When the testicle grows into a tumor, its internal venous circulation is destroyed, and the veins of the scrotum are distended; and when a tumor forms in any part of the body, it soon obliterates those veins with which it comes in contact.

The veins are subject to morbid changes, similar to those which occur in the arteries, but the most common alteration observable in them is dilatation. This arises from such a variety of causes, that a varicose state of the veins is a very common disease, and is productive of more or less distress, according to the situation of the dilated veins. Wherever the veins are of great length, and have to circulate the blood against its gravity, more especially if there are few valves, or if the valves lose their power, they are apt to become varicose,—hence the disease most frequently occurs in the saphenæ veins, and in those of the spermatic chord and the rectum.

VARICOSE STATE OF THE VENÆ SAPHENÆ.

The superficial veins of the upper extremities rarely become varicose. When compared with the deep seated veins, they are larger in proportion than those of the lower extremities, the communication betwixt both sets is particularly free, and the blood, in its return to the heart is not so liable to interruption ; whereas, in the lower extremities, not only have the veins to circulate the blood against its gravity, but in the violent actions of those limbs, the deep seated ones are so frequently compressed, that those which are superficial are occasionally subject to great distention. This distended state of these vessels, is al-

so produced by whatever obstructs the flow of blood in the superficial trunks, and, if the distending force is long continued, the valves lose their power, and the coats of the vessel, having then to sustain the pressure of a large column of blood, become permanently dilated. While the veins are gradually dilating in diameter, they are at the same time acquiring additional length, and having now assumed a diseased action, they become thickened in their coats. Although the diseased vessel undergoes a change in the whole of its course, there are some portions which are more remarkably dilated than others, and these are immediately above the valves, at those points which are called the sinuses of the vein. From the increased length of the varicose veins, they assume a tortuous form; from the thickness of their coats, they are firm to the feel; and from the most remarkable dilatations being situated close upon the valves, they form distinct tumours of a brownish red, or livid colour. These are greatly diminished in size, and sometimes wholly disappear when the patient is in the recumbent posture. When small they are generally free from pain, but when they acquire a large size, they often become extremely painful, and inflammation in the skin and cellular substance is excited. The disease occurs more frequently in the branches of the saphena major, than in those of the saphena minor. It is therefore generally situated in the course of the former vein, sometimes ex-

tending all along the inner side of the leg and thigh, at other times only occupying small and distinct portions of that vessel. The varix is generally filled with fluid blood, but sometimes the blood coagulates in the tumor and fills up its cavity. An obstruction is then given to the circulation, which is thrown upon the collateral branches; the diseased vein shrinks and is converted into a solid cord; and thus a spontaneous cure is effected in the same manner as in aneurism.

Varicose veins frequently burst. This has happened in the large internal veins, and has proved fatal. It also sometimes occurs in the dilated veins of the rectum and colon, by which the patient loses such quantities of blood as to be attacked with dropsy, or to have his health irretrievably ruined; and in the lower extremities, varix often inflames the skin and gives rise to troublesome ulcers, which are on many occasions attended with copious venous hemorrhage. Pregnant women, especially those who have had many children, people far advanced in life, or who, from their occupation require to be much in the upright posture, are the most subject to this disease, which is commonly induced by the pressure of the impregnated uterus upon the external iliac veins, by tumors compressing these veins or the femoral or saphena veins, by wearing tight garters, or by whatever prevents the return of the refluent blood to the heart.

TREATMENT OF VARIX IN THE SAPHENÆ VEINS.

There are two methods of treating varices of the saphenæ veins. One is a radical and the other a palliative treatment. The ancients had recourse to the radical treatment, and many of the moderns have followed their example; but the practice has been so frequently succeeded by violent constitutional derangement, and even by death, that it is now seldom adopted. This treatment consists in obstructing the flow of blood through the varicose vein, and permanently obliterating its cavity, so that the circulation shall be thrown upon those healthy veins in which the action of the valves is perfect,—such as the deep seated veins and the smaller subcutaneous branches. The ancients effected the object in view by means of the actual cautery, and by excision; the moderns by ligature, by excision, and by compression either after the division of the venous trunk, or after the evacuation of the contents of the varix by incision. Sir E. Home has frequently tied the saphena vein in ulcers of the legs, attended by a varicose state of the subcutaneous veins, and the operation was followed by a diminution of the dilated veins with a rapid healing of the ulcer; and the practice of including the trunk of this vein in a ligature, has been adopted by many modern surgeons. The operation is extremely simple, consisting in pinching up the skin above the

vein as it passes over the inside of the knee, and cutting it across in such a manner that the incision may be situated upon one side of the vessel, and running parallel to it. A ligature is then to be carried under the vein by means of an aneurismal or blunt-pointed surgical needle, and after it is tied, the edges of the wound are to be brought together and retained by adhesive plaster and bandage. When the surgeon has recourse to excision, two ligatures must be passed, one above and one below the diseased portion of vein, and after they are tied the intermediate piece is to be dissected out. The third method of obtaining a radical cure, is effected by exposing the trunk of the vein by incision a little above the knee, then cutting it across and laying its sides in contact by compress and bandage, or by making an incision into the varix itself, evacuating its contents, and then employing compression.

All these methods having been attended with such alarming symptoms, and on some occasions even proving fatal, surgeons have abandoned the practice, and have now recourse to a palliative treatment. Even when they have succeeded, the cure has not been in all cases permanent, as the anastomosing veins on which the new circulation has been thrown, have, after a time, dilated and re-produced the disease.

The palliative treatment of varicose veins, consists in diminishing the pressure of the column of

blood, and affording uniform support to the dilated vessels. The means of effecting these purposes are horizontal posture and gentle compression; and when this practice is resorted to early, and the disease is not very extensive, it sometimes effects a radical cure. Conjoined with this treatment, the application of astringents is useful, and the best of these are decoctions of oak bark, and solutions of galls. When the skin is of a dark red colour, and the tumor hard and painful to the touch, we confine the patient to a horizontal posture, apply to the inflamed parts cold saturnine lotions, and exhibit one or two doses of a saline cathartic. When the inflammation and pain are gone, we apply to the dilated vessels compresses wet with the astringents, and support the veins by a flannel or cotton roller, carried with a moderate and uniform degree of tightness, from the points of the toes to the top of the thigh; or if this should be inconvenient to the patient, we have recourse to the laced stocking. By pursuing these means, if a radical cure is not obtained, the disease will at least be productive of little inconvenience.

CIRCOCELE.

Circocele is an enlarged or varicose state of the spermatic veins. The disease is very frequent in warm climates, and is produced by

whatever compresses these veins, and prevents the free return of the blood to the abdominal cava. Hence it arises in consequence of tumors pressing on the upper part of the chord, from an enlarged or inflamed gland lying in the abdominal ring, or from the awkward pressure of a hernial truss. Sometimes it takes place slowly without any apparent cause. Petit says, he has remarked, that swelled and diseased liver, which is frequently the cause of hemorrhoids, is also often the cause of circocele. As the spermatic veins do not empty themselves into the vena portæ, the disease, in this case, must arise from the pressure of the enlarged liver, either on the abdominal cava, or on the termination of the spermatic veins. Petit and Callisen imagine, that circocele occurs oftener in the left side than the right, which they attribute to accumulated and hardened fœces in the sigmoid flexure of the colon, compressing the chord, and obstructing the venous circulation; but I conceive, that this doctrine is more hypothetical than real. I have seen the disease as frequently in the right side as in the left, and in the only cases where it was necessary to perform an operation, the disease was situated in the right side.

Circocele from the pressure of the enlarged veins on the testicle, is generally attended with a sickly feeling, sometimes with acute pain stretching to the loins, accompanied with a numbness of the thigh, and sometimes the pressure is so

great as to destroy the office, or ultimately to obliterate the testicle, producing the same effects as castration.

In circocele, the dilated veins are in the spermatic chord and epididymis, and not in the body of the testicle. They are always larger in warm weather and after much exercise, and look and feel like a parcel of earth worms, or like the intestines of a bird, or the injected vesiculæ seminales. The chord is fuller, and the testicle hangs lower than that of the opposite side. When the dilatation of the veins is considerable, and more especially when it extends within the abdominal ring, the disease is very apt to be confounded with omental hernia, and there is but one distinction which however is very decisive. We place the patient in a horizontal posture, and press the contents of the swelling towards the abdominal ring, and we then grasp the upper part of the chord betwixt the forefinger and thumb, at the same time desiring the patient to get upon his feet. If, then, the disease be an omental hernia, all return will be prevented while the chord is held in this situation; but if the veins are varicose, the swelling will not only instantly return, but be much increased, while the chord is thus compressed, and the return of the blood prevented.

TREATMENT OF CIRCOCELE.

In the management of varicose veins of the spermatic chord, as well as those of the lower extremities, we have recourse either to a palliative or a radical treatment. When the disease is not accompanied by any violent pain, and the pressure has no destructive influence on the testicle, we suspend the parts by means of a suspensory bandage, employ frequent cold ablution or sea-bathing, keep the bowels open, and enjoin as much as possible a horizontal posture. However, the natural effect of the disease, is to obliterate the testicle and produce great pain; therefore, when the pain is extremely violent, and more especially when the testicle begins to waste, the radical cure may be resorted to, and the veins dissected out. But this operation is rather to be avoided, as being difficult to execute and not void of danger. It is only when the pain is very great, when we are afraid of the testicle being obliterated, or when the patient insists on it, as is sometimes the case, that we operate,—although I believe, that inflammation is not near so apt to follow the ligature of the smaller, as that of the larger veins.

For the cure of circocele, the ancients recommended either the actual cautery, or to place a ligature round the diseased vessels, and then to cut

them out, and they sometimes even extirpated the testicle. Mr. Sharp comparing the varicose state of the spermatic veins, with those that are dilated in other parts of the body, recommends dissecting them out; but this operation has been performed amongst the moderns, chiefly by Petit and John Bell.

In performing this operation, the patient must be seated in an arm chair, placed on a sofa, or laid across a bed; and the surgeon then grasps the diseased parts in his left hand, with such a degree of firmness as to make them protrude. To expose the varicose vessels, he makes an incision through the skin and tunica vaginalis, the whole length of the scrotum. As soon as this incision is completed, the testicle falls out, and is seen of a globular form, with the chord full of tortuous and blue veins. It is necessary that this incision should be extensive, otherwise the surgeon has not room to dissect out the veins. He has no sooner passed his ligatures and begun to cut, than the chord is obscured with blood, the veins slip from betwixt his fingers, and he finds himself involved in a difficult dissection. The incision, therefore, should not be confined to the diseased portion of the chord, but should, on all occasions, extend to the bottom of the scrotum. When the chord is fairly exposed to view, the surgeon, with his fingers, separates the varicose veins from the other parts of which it is composed. He passes one ligature betwixt the veins and the chord at

its bottom, and another at the top. He then ties the ligatures and cuts the diseased vessels away with scissars, taking care not to cut across the chord which would emasculate his patient. After the varicose veins have been cut off, the testicle must be instantly returned into the scrotum, and the lips of the wound brought together by means of the interrupted suture, and adhesive or black court plaster.

Although I have described this operation for the cure of circocele, and although it has been frequently done with success, still it is so difficult to accomplish, that nothing but the most urgent reasons should induce us to undertake it,—such as violent and continued pain or wasting of the testicle, conjoined with the earnest entreaties of the patient.

HEMORRHOIDS.

A dilated state of the hemorrhoidal veins is productive of tumors called hemorrhoids or piles. These tumors are sometimes situated within the gut, and sometimes they are placed round the margin of the anus. They occasionally burst and discharge such large quantities of blood, as to debilitate and cause great exhaustion in a delicate constitution. When the hemorrhoidal tumors are placed high in the rectum, they are attended with little pain, as the veins do not then suffer much

compression; when situated externally, they are often extremely painful, and form hard tumors from the size of a hazel nut to that of a walnut, of a dark blue colour, and surrounding the margin of the anus; but the pain is excruciating and hardly supportable, when they happen to be placed within the grasp of the sphincter, because the action of that muscle strangulates the tumor, and increases the inflammation. When an external pile is uninflamed, the tumor is soft to the touch; but when it inflames, the coats of the vein become thickened, and coagulating lymph is frequently effused into the adjoining cellular substance. The tumor, in this case, feels hard, and is painful to the touch; the blood in it coagulates, and the parts become massed together by inflammation; thus a tumor is formed which is firm, hard, and somewhat solid. This occasionally inflames, and swells upon the application of cold, and requires at a future period to be removed either by the knife or by ligature. The inflammation of the tumor often extends to the cellular substance, and sometimes terminates in the formation of an abscess, which, after the discharge of the matter, does not heal, but degenerates into a fistulous sore. When the tumors are situated within the gut, and are of a large size, they are productive of great irritation, they prevent the free expulsion of the fœces, and protrude at each evacuation, producing at the same time an inversion of the intestine.

The hemorrhoidal veins, like those of the inferior extremities and spermatic chord, are apt to become varicose upon the slightest obstruction to the return of the blood. All the veins of the intestines terminate in the vena portarum of the liver, they have no valves, their circulation is extremely languid, and any compression in their course causes them to swell into tumors, which, when inflamed, are very painful. This compression is sometimes occasioned by scirrhous liver and ascites, but most frequently arises from pressure by the impregnated uterus, and by hardened fœces in the rectum,—hence women are much more subject to hemorrhoids than men, both during the state of pregnancy, and from being naturally of a more costive habit.

TREATMENT OF HEMORRHOIDS.

Hemorrhoids, like dilated veins in other parts of the body, must be treated in a palliative or radical manner, according to circumstances. When the disease is not very severe, we unload the bowels by means of a laxative glyster, and keep them open with an electuary made of equal parts of the flowers of sulphur and the supertartarate of potash, we enjoin a horizontal posture, apply to the tumors cold saturnine poultices, and when the inflammation abates, the common hemorrhoidal ointment of the pharmacopeias, composed of six

parts of simple ointment and two parts of oak galls. But if a hemorrhoid becomes violently inflamed, feels hard, and is very painful, leeches should be immediately applied to it, or it may be laid open with a lancet. The inflammation subsides in a few hours, and the tension and pain then go off. When laid open, the hemorrhage is in general trifling, but should it become dangerously profuse, the surgeon always has it in his power to suppress it, by the introduction of a small piece of sponge into the vein. These means seldom fail to give such relief as soon to enable the patient to pursue his usual occupations; but the disease in general is so distressing, and the attacks so frequent, that a radical cure is earnestly sought after. The method proposed to effect this, has been extirpation, either by the ligature or the knife. If a ligature be applied to an external pile in an inflamed state, it will produce pain almost insupportable; and if the tumor is internal, there is considerable risk of inducing intestinal inflammation, which on some occasions has occurred and been followed by death. Again, if we have recourse to extirpation by the knife, we are in danger of hemorrhage, which may prove fatal. I know of no instance where this has happened, but Petit mentions a case, where after excision, a hemorrhage succeeded which proved fatal in five hours, and the rectum and colon were filled with blood. Extirpation by the ligature appears to me to be applicable to hemorrhoids,

only when they are situated externally, when the inflammation is gone, and when the tumor is loose and pendulous. If the tumor has a narrow base, we may at once include the whole in a ligature; but if the base is broad, we pass a surgical needle armed with a thick ligature through the centre of it, and separating the threads, carry one half round one side, and the other half round the other, when they are to be firmly tied. The tumor drops off in the course of two or three days, or by that time the circulation is so completely destroyed, that it may be cut off with scissars, and the inflammation, which has been induced in consequence of the ligature, consolidates the surrounding parts, and frequently prevents a return of the disorder. The cure by excision like that by ligature, should also be restricted to external hemorrhoids, and should be employed, only when the tumor is firm and fleshy, as there is then no danger of hemorrhage. In the solid state of the tumor, its removal by the knife is both expeditious and safe; and the best way to effect it, is to pass into it a hook, and cut it off by a scalpel at its base.

We have said, that the practice of removing hemorrhoidal excrescences by ligature, and by excision, is applicable only when they are situated without the anus, but the common practice of surgeons is to adopt this treatment, even when they are situated within the gut. This is recommended by Sir James Earl, and Mr. Ware, but it

is not without danger. I have seen considerable pain and violent symptomatic fever produced by the ligature, and cases have occurred where there succeeded swelling and tension of the abdomen, retention of urine, vomiting, hiccup and death.

If we attempt the removal by excision when situated internally, it is possible that there may follow a fatal hemorrhage. As there are no valves in the whole system of the porta, the varicose tumor is exposed to the pressure of a large column of blood.

From the consideration of these circumstances, I should be inclined to trust the cure of internal hemorrhoids to astringent injections, such as solutions of alumn, the sulphate of zinc, and decoctions of oak bark; and when the irritability has subsided, employ pressure by means of large crystal bougies.

SECTION. IV.

ACCIDENTS OF THE VEINS.

The veins, as forming a part of the circulating system of vessels, are liable to accidents, similar to those of the arteries; but the effects of external injury are modified in them by the difference of their organization. Thus, from the greater delicacy of their coats, the veins are more easily ruptured than the arteries; and from their being

more apt to inflame, wounds of them are more frequently followed by a fatal inflammation. This greater susceptibility of inflammation, is the more formidable from its tendency to spread along the continuous surfaces.

The accidents of the veins, which most frequently engage the attention of the surgeon are wounds, although these vessels are also very liable to burst upon any strain or sudden exertion.

WOUNDS OF THE VEINS.

A wound in a vein is distinguished from that in an artery, by the blood being poured out in a slow and continued stream, by its being of a dark colour, and by the hemorrhage being easily stopped by pressure. From the slowness with which the blood is discharged, and from its evacuation having a less direct influence upon the action of the heart, than arterial hemorrhage, a greater quantity of blood may be lost from these vessels without producing such alarming effects on the system. Hence the wound of a vein is not attended with such *immediate* danger as that of an artery. If a vein is divided in a longitudinal direction, as there is little impulse upon the sides of the vessel, the edges of the wound remain in contact, or at least the slightest support enables them to maintain this position. The vessel, in this case, does not bleed, unless pressure be em-

ployed betwixt the wounded point and the heart; but if the vein be divided transversely, the lips of the wound retract, blood is discharged profusely, and it requires powerful pressure to suppress the hemorrhage.

We are as yet ignorant of the process by which nature puts a stop to venous hemorrhage, and permanently closes the wound in the vein; but it appears, that if the wound be longitudinal or oblique, and a slight degree of pressure be applied, as after phlebotomy in the superficial veins, the vessel will still remain pervious and the circulation be continued in it. But if the wound be transverse, and considerable pressure be employed to stop the hemorrhage, the cavity of the vessel will be obliterated, and the circulation thrown upon the collateral branches.

In stopping arterial hemorrhage, we give the preference to the ligature, and this would also seem to be the most direct means of suppressing venous hemorrhage. Experience teaches us, that the practice is not always safe. The application of ligatures to veins, both for the cure of varix, and in wounds, has been followed by alarming symptoms, which in many cases have terminated in death*. I have seen the axillary vein cut in

* See Hodgson on the diseases of the arteries and veins; and a paper on the ligatures of veins, by Mr. Travers, in part 1st of Surgical Essays, by Messrs Astley Cooper, and Benjamin Travers.

the removal of tumors from the axilla on two different occasions, and in both these cases the vessel was secured by ligature. In one of them no bad symptoms followed, but in the other there succeeded high symptomatic fever, attended by rigors, vomiting, and great pain in the epigastric region, and under the sternum. The patient died on the ninth day, and upon dissection, the two ligatures with which the vessel was secured, were found firm round it, and the vein in their immediate vicinity was much thickened in its coats, and plugged up with clots of blood close by the ligatures. Below the lower ligature, the inner coat of the vessel was of a deep claret colour, which extended for some space into the basilic vein. Above the upper ligature, the inner surface of the vessel had the same appearance, it contained depositions of coagulating lymph as far as the subclavian vein, but no purulent matter; and the inflammation extended along the whole continuous surfaces into the right auricle of the heart, which was tinged with as deep a colour as the inner surface of the veins. The left auricle was of its natural appearance.

I apprehend, that the ligature should never be employed in wounds of the veins, more especially as the hemorrhage may always be easily suppressed by compression, either without or within the wound. Even when a large vein is wounded, such as the axillary or inguinal vein, a bit of lint or a piece of sponge pushed into the wound, will ef-

fectually stop it. This plug may be easily removed when suppuration is established, and the wound in the vessel healed.

Before concluding this subject of the diseases and accidents of the blood-vessels, I may observe, that while our pathological enquiries have been so successfully directed to the arteries, the peculiarities of the venous system have been almost entirely neglected. It is only of late years that the dreadful effects of ligatures upon veins have been distinctly brought under the review of the profession; and this fact, in conjunction with various other circumstances, leads me to believe, that requisite attention to this division of the animal œconomy, will prove no less beneficial to practical surgery, than those labours with respect to the arteries which reflect so much honour on Dr. Jones.

CHAP. XII.

BLOOD-LETTING.

The abstraction of blood from the system has been a favourite operation since the earliest ages of surgery, and has been practised more or less frequently, according to the prevailing doctrines of the times. There is no operation so immediately useful as blood-letting. By means of it we lessen the quantity of blood circulating in the vessels, diminish the force of the contractions of the heart and arteries, prevent the determination of blood to a particular organ, and induce other important changes in the system. Blood-letting has been divided into Topical and General. Each of these methods of abstracting blood is attended with advantages, and is occasionally resorted to, according to the various forms of disease. Thus, in disorders purely local, we generally have recourse to topical bleeding; where, on the other hand, there is a general affection or an increased action of the heart and arteries, we employ general bleeding, and in those cases again, in which there is both a local and a constitutional disease, we have recourse to each of those modes, topical and general.

SECTION I.

TOPICAL BLEEDING.

Topical blood-letting is employed to lessen the quantity of blood in a particular part, or to diminish the action of the arteries immediately leading to the seat of the disease; and the operation may be accomplished in two ways, either by scarification and cupping, or by means of leeches.

SCARIFICATION AND CUPPING.

Scarification with cupping, was a favourite operation among the ancients. It is recommended by the generality of systematic writers, but of late years has rather fallen into disrepute in this country. The operation consists in applying to the skin the scarificator, which is a brass box containing from twelve to sixteen lancets. By means of a spring, the points of the lancets are thrown out to a certain extent, which is adjusted by a regulator. The vessels of the surface are thus divided, after which the cupping-glass is applied in order to promote the bleeding, which it does upon the principle of the air-pump. Before the scarificator

is used the cupping-glass should be applied to the part, to produce a redness and tumefaction, as unless this is done a sufficient quantity of blood will not easily be procured.

In performing this operation, we proceed in the following manner. The part to which the scarificator is to be applied, must be well rubbed with a warm cloth; we then take a little tow or a bit of bibulous paper made wet with the spirit of wine, set fire to it, and insert it into a cupping-glass. This rarifies the air in the glass, and when the light is nearly extinguished, we place the glass upon the skin. When the light expires, the air remaining in the glass becomes compressed, from the pressure of the atmosphere on the surrounding parts, and that portion of skin which the glass encloses is forced up and reddens. After this effect is produced, the glass is to be removed and the scarificator applied in its stead. This instrument, properly adjusted by the regulator and its own handle, must be held firm upon the place while the lancets are discharged, which is done by pressing with the point of the thumb upon the button at one of its sides. After the incisions are made, the scarificator is to be laid aside, and the cupping-glass re-applied as recommended above. The blood flows into the glass, which is to be removed as soon as it has received as much blood as the air contained in it will permit. Another glass is to be applied immediately, and the process is to be repeated as long as the blood con-

tinues to flow, taking care at each removal to bathe the parts with warm water and a sponge. If a sufficient quantity of blood is not procured, the scarificator must be re-applied, and in such a manner as to make the second incisions cross the first. After the operation is finished, the best dressing is a bit of lint dipt in oil or spread with simple ointment.

LEECHES.

Another and very frequent method of employing topical bleeding, is by means of leeches. Their application produces less irritation than scarification and cupping, and they possess this advantage, that the surgeon is able to apply them to situations where he cannot use the scarificator, as to the face, the throat, scrotum and anus. There is sometimes considerable difficulty in getting leeches to fix upon the part to which we wish to apply them, but this may be in a great measure obviated by attending to the following directions. The leeches should be permitted to crawl about upon a dry cloth for an hour previous to their application, and the part to which they are to be applied should be rubbed with a little sugar and cream immediately before they are presented; but if the skin is inflamed a little cold water is preferable. If they should, notwithstanding, refuse to fasten, the skin should be slightly prick-

ed with the point of a lancet or a needle, so as to bring blood, when the leeches will in general immediately fix. The best way to apply them is, by placing them in a wine glass, or on a piece of linen, and then presenting them to the part upon which we wish them to fasten. When the leeches have sucked as much blood as fills them, they fall off of their own accord; they are then to be placed upon a plate, and made to discharge their contents by means of a little salt, sugar, or vinegar, sprinkled upon their mouths. After they have disgorged the blood, they are to be put into clean water and preserved for farther use. If the leeches should not disengage themselves after they are filled, they may easily be removed by the fingers; and if these animals cannot be obtained in sufficient numbers, the requisite quantity of blood may always be readily obtained from a few, by cutting off their tails during the act of sucking, when the blood will be discharged at the one end as rapidly as it is taken in at the other. They are not immediately discomposed by this treatment, but generally die after it. As the quantity of blood which the leeches abstract by sucking is inconsiderable, it is necessary to promote the bleeding after they fall off, and this may be done either by the application of cupping glasses, by fomenting the orifices with warm water, or by applying warm cloths or hot poultices.

The bleeding from the bites made by leeches, generally ceases of its own accord; if not, it may

be always easily stopped by compression, or by applying to the orifices a little down taken from a hat, conjoined with pressure; but as it is generally difficult to employ compression in an infant, I would advise that in them care should be taken not to apply leeches to a large vein.

SECTION II.

GENERAL BLEEDING.

General blood-letting consists in opening an artery or a vein with a lancet. The former of these operations is termed Arteriotomy, and the latter Phlebotomy or Venesection.

ARTERIOTOMY.

The abstraction of blood from an artery, has a more manifest effect in lessening vascular action, and depressing the powers of life, than that from a vein, and therefore, on some occasions arteriotomy is resorted to in preference to phlebotomy. Any of the smaller order of arteries that are situated superficially, and are placed upon a bone, may be opened with safety, as the wounded vessel can be effectually compressed against that bone; but

the operation is confined to the trunk and branches of the superficial temporal artery. This vessel is situated very superficially, and is the only artery of its size which runs above the fascia; accordingly it is frequently opened in mania, apoplexy, and other determinations of blood to the head.

The temporal artery may be opened in its trunk where it passes over the zygoma, or in its branches in the temple. When the integuments are thin, and the course of the vessel can be easily traced, the lancet may be passed into it at once in an oblique direction; but when the pulse is obscure, and the course of the artery not very distinct, it will be preferable to make a preliminary incision, and this is best done by carrying the edge of the lancet, for a little way, through the skin, obliquely across the vessel. If the lips of the incision be separated, the artery will be seen, or at least its pulsation will be so distinctly felt, that it may be opened with the greatest ease. When as much blood has been abstracted as is wished for, the edges of the wound should be put together. A bit of lint is then to be placed over it, with a piece of chewed paper, and a compress of linen over that; or we may use a piece of linen containing a halfpenny or other coin,—securing the whole by means of the twisted roller, described and delineated in pages 484, and 485, of volume 1st. This will, in most cases, effectually compress the artery against the bone,

and prevent any farther bleeding; but should this fail, and the vessel still continue to bleed, the artery must be completely cut across by the lancet, when both ends will retract. This conjoined with compression will prevent all farther hemorrhage.

PHLEBOTOMY.

The older surgeons were in the practice of drawing blood from numerous branches of the venous system, such as the veins of the neck, the ankle, the bend of the arm, the hand, the eye, the tongue, and the penis; but the surgeons of the present day restrict the operation to the three former. I shall describe the course and connection of the veins in each of these situations, and mention what I conceive to be the easiest and safest mode of performing venesection: but I may remark, that wherever it is to be performed, all that is necessary for the surgeon to do, is to compress the vein near the point to be opened, and betwixt it and the heart,—to steady the vessel by pressure with his thumb at the moment he introduces the lancet, after which the thumb is to be removed,—and to continue the former compression as long as he wishes the blood to flow.

BLEEDING IN THE NECK.

Most of the superficial veins of the head and face empty themselves into the external jugular, near the angle of the jaw. From this point, the trunk of the vessel runs down along the side of the neck, crosses the mastoid muscle, and empties itself into the subclavian vein above the clavicle. In its whole course, it runs below the fibres of the platysma myoides, which, from lying immediately under the skin, are cut in all operations on the neck. The external jugular vein is quite unconnected with any artery or important nerve, so that it may be opened with the greatest safety; but the preferable point for entering the lancet, is at that place where the vein crosses the mastoid muscle.

In bleeding in the jugular vein, it is necessary to lay the head of the patient upon a pillow properly supported, or to recline it upon the breast of an assistant. The surgeon is then to carry the thumb of his left hand upwards along the vein, and at the edge of the mastoid muscle to make a pressure upon the vessel sufficient to make it swell. While the vessel is now turgid, he is to push the lancet into it, in an oblique direction, a little above the point of pressure, and immediately over the muscle. When the vein is opened, the blood flows as long as the pressure is continu-

ed; but it generally ceases to do so when it is withdrawn. As soon as the requisite quantity of blood is obtained, the pressure is to be removed, the edges of the wound are to be kept together by means of a strip of black court plaster, and a compress of linen is to be applied over it, and secured by a roller round the neck drawn moderately tight.

BLEEDING IN THE ANKLE.

It is the internal saphena vein that we open when we bleed in the ankle. This vein commences betwixt the first and second metatarsal bones. At this point, it inosculates with the external saphena, by means of a branch which runs in an arched form across the lower and fore part of the foot, and which receives the superficial veins of the toes. It then runs upwards over the inner ankle, proceeds along the inside of the leg, passes the knee-joint a little behind the inner condyle, keeps the inside of the thigh, and enters the femoral vein about an inch and a half below Poupart's ligament. In its course along the leg and thigh, it inosculates freely with the branches of the external saphena, and becomes gradually larger, from the additional veins which it receives.

The point at which we open the saphena veins, is where it passes over the inner ankle or a little

below it. The vessel is here quite superficial, is unconnected with arteries or nerves, and may therefore be cut with the greatest safety. From the smallness of the vessel, and from the shortness of the column of blood below the orifice, this vein in general does not bleed freely. After a ligature, therefore, has been placed above the ankle, sufficiently tight to compress the veins, in order to promote the bleeding the foot should be immersed in warm water for some time before the operation, and when the veins have become sufficiently conspicuous, the foot is to be taken out and dried. The surgeon should now place it upon a low seat, lay his left thumb upon the most conspicuous vein, and make such a degree of pressure as to keep it firm, while, with the thumb and fore finger of his right hand, he introduces the lancet in an oblique direction. He then withdraws both his hands, and if the blood does not flow freely, he must again immerse the foot in warm water. The immersion of the foot in warm water after the vein is opened, should not be had recourse to if the vessel will otherwise bleed, as it prevents the surgeon ascertaining the quantity of blood drawn. Upon the removal of the ligature, the bleeding, in almost every case, immediately ceases, and all that is required, is to keep the edges of the wound together by a strip of black court plaster, and to apply a compress and roller.

BLEEDING IN THE ARM.

There are two sets of veins in the arm, as in every other part of the body,—one subcutaneous and the other deep seated. The subcutaneous or external veins lie above the fascia, are as a supplement to the internal veins, and receive and convey the blood, when, by the strong actions of the arm, it moves on less freely in the internal veins. For this purpose, the communication betwixt the two sets is particularly free about the elbow joint.

The external or subcutaneous veins are three in number, the Cephalic, the Basilic, and the Median.

1*st*, The cephalic vein runs all along the outer edge of the arm, and derives its name from a whimsical opinion of the ancients that it had a greater connection with the head than any of the other veins. It begins upon the back of the thumb near its root, and is at this point named Vena Cephalica Pollicis. However, this is not its sole origin, as it also comes in an arched form from the back of the hand, where it communicates with the basilic vein. In its course along the arm, it passes by the outer condyle, and at this point the branches of the external cutaneous nerve come out, and run along it, rendering it dangerous to open it. The cephalic vein receives

none of the deep seated veins, but runs upwards, of one uniform size, keeping upon the outside of the biceps, and by the inner side of the deltoid muscle. It runs distinct from all the other veins, and has no communication with them from the elbow upwards. It passes over the shoulder, and pours its blood into the axillary vein, which is the termination of all the other veins of the arm, and where only the cephalic vein is united with them.

2d, As the cephalic vein runs along the radial edge of the arm, the basilic passes along the ulnar. It arises, like the cephalic, upon the back of the hand next the little finger, as the other does next the thumb,—the one being named Cephalica Pollicis, the other Vena Salvatella. These two veins collect all the blood from the back of the hand, and back of the forearm. They are always united by an arch upon the back of the hand, and in general again at the wrist. From this point they diverge, one running along the outer, and the other the inner edge, till they gain the fore part of the arm. The basilic vein goes along the inner edge of the arm over the inner condyle, and up along the inner side of the biceps muscle, perforates the fascia low in the axilla, and comes close upon the artery along which it then runs. As this vein receives all the venæ comites, or deep seated veins, it is to be considered as the great trunk, and very greatly exceeds the size of the cephalic.

3d, As the cephalic and basilic veins gather up the blood from the back of the hand, so the interior part of the forearm also requires an appropriate vein, and that vessel lying in the middle of the arm is named the Median vein. The median vein is not continued as a distinct vein up to the axilla, like the cephalic and basilic veins, but delivers its blood into these vessels at the elbow, by two oblique communications, and hence, according to the fulness of the cephalic or the basilic vein, it can pour the whole of its blood into either. It arises by small branches about the palm of the hand, but begins only about the wrist to be conspicuous as a trunk. It runs up as a single vein nearly to the bend of the arm, where it divides into two branches. One branch runs inwards and terminates in the Basilic, called the Median Basilic, and the other runs outwards and terminates in the cephalic, called the Median Cephalic. These two vessels are the veins most commonly opened in the operation of phlebotomy at the bend of the arm.

Choice of a vein.—In opening a vein at the bend of the arm, we seldom fix either upon the cephalic or the basilic, but generally prefer the medians. The cephalic has less communication with the other veins, lies so loosely in the cellular substance, that after it is opened, the internal is apt to slip from the external orifice, and is, besides, the vein to which the branches of the external cutaneous nerve attach themselves. The

basilic is often too large a vein, particularly in strong arms, it is quite surrounded by the internal or great cutaneous nerve, and a considerable branch of this nerve also runs down along the median basilic to the median vein.

It appears, then, that the cephalic, basilic, and median basilic veins, are surrounded by nerves. The median cephalic is the least connected with them, and if the wounding of nerves be dangerous, this vein should be our choice. The median cephalic is more free of nerves than the other veins, is situated in that part of the bend of the arm most convenient for being opened, lies on the outside of the biceps tendon, and is sufficiently distant from the artery. On these accounts we prefer it. The median basilic runs in an opposite direction towards the inside of the tendon, and crosses both it and the artery obliquely; but the artery can always be felt beating, it lies deep, and when wounded, the lancet must pass through the skin, vein and fascia. When the artery lies deep its pulsation is obscurely felt, when situated more superficially, its stroke is acute. By this circumstance, it is easy to calculate the degree of danger, although there can be very little in the hands of a well-informed surgeon. The median basilic then, is almost as unexceptionable as the median cephalic. Speaking in a general way, we decline the cephalic and basilic veins as too large, and as lying upon the edges of the arm; and rather take the median cephalic, and median ba-

silic, as being more conveniently placed in the bend of the arm; but we prefer the median cephalic to the other three, as farthest from the artery, and the least connected with nerves.

The essential apparatus for bleeding in the arm consists of a ligature or ribbon to compress the veins, a lancet, and a compress, with a ligature to bind up the arm after the operation. If the patient is not particularly liable to faint, both he and the surgeon should be seated, as being the most convenient posture for the operation. If he is apt to faint, he should be bled in the horizontal position, unless fainting is to be desired; in which case the upright posture is preferable, at the same time that the blood is to be abstracted from a large orifice.

The position being arranged according to the effect that is wished to be produced, the surgeon should take the ligature or ribbon, spread it out, and carry it up along the surface of the forearm, in the course of the veins, till he arrives at two inches above the elbow, when it should be passed twice round the arm. The ligature should be tied with a running knot, on the outside of the arm so as not to incommode the operator, and it should be pulled sufficiently firm to make the veins swell, but not so tight as to stop the flow of blood in the artery, which can always be ascertained by the pulsation at the wrist. When the veins have become turgid, and the surgeon has made choice of one, he should, with the thumb

of one hand, press firmly upon it a little below the point he means to op ı, so as to keep it steady, while he takes the lancet betwixt the thumb and forefinger of the other, and introduces it into the vein in an oblique direction. After he has fairly entered the vein, he should bring the point of the lancet directly upwards through the skin, by which he will not only avoid transfixing the vein, but make the wound in it and in the skin equal. Immediately after he has done this, he should remove the thumb which steadied the vessel and allow the blood to flow. After the introduction of the lancet, and in order to enlarge the orifice, some surgical writers direct to raise and carry forwards the anterior edge or shoulder of the instrument; but this practice is maifestly improper, as by doing so, the point of the lancet must be depressed, which endangers the transfixing of the vein, and if the median basilic be the subject of operation, it may even wound the artery.

When the lancet is withdrawn, the surgeon should support the patient's arm while the blood is flowing, and it should be kept in the same posture in which the instrument was introduced, otherwise the internal is apt to slip from the external orifice, by which means the blood will be effused into the cellular substance, and the bleeding will be stopped. It sometimes happens, that although the vein has been fairly opened, the blood, notwithstanding, does not flow freely, in which case

the bleeding may be promoted by making the patient grasp and turn alternately in his hand the lancet case, a stick or other round body. This makes the muscles of the forearm compress the deep-seated veins, and thus force the blood into the superficial ones, through the communications which are particularly free about the elbow joint.

After the requisite quantity of blood has been obtained, the surgeon unties and removes the ligature, at the same time compressing the vein with his thumb, immediately below the orifice. He then brings the edges of the wound together by means of a strip of black court plaster, over which he places a compress, and secures it by means of a roller passed round the elbow in the form of the figure of 8.

SECTION III.

DANGERS FROM BLEEDING IN THE ARM.

Since the time that it was first practised, dangerous consequences have been occasionally found to follow the simple operation of bleeding in the arm. The older surgeons believed that the chief danger occurred from the wounding of the tendon of the biceps muscle; another class of surgeons ascribed it to the pricking of a nerve; and

a third maintained that it arose from the inflammation of the vein. As it is now ascertained, that the tendons possess no sensibility, the first of these hypotheses has been forsaken; but the opinions as to the wound of the nerve and the inflammation of the vein are still maintained, and the truth of them is justified by what daily occurs in practice. But, independently of these two occurrences, other evil consequences have been found to succeed to the operation of bleeding. These have been at various times observed, but it is only by the surgeons of the present day that they have been discriminated and arranged.

The dangers arising from bleeding in the arm may be enumerated as follow. 1*st*, Ecchymosis; 2*d*, Inflammation of the skin, and subjacent cellular substance; 3*d*, Inflammation of the absorbents; 4*th*, Inflammation of the vein; 5*th*, Inflammation of the fascia; 6*th*, Wound of a nerve; and 7*th*, Wound of the artery with its consequence, aneurism.

The latter of these affections I have already considered, and of the others I shall say a few words in order.

1*st*, Ecchymosis.—In consequence of the wound in the vein slipping from the wound in the skin, the blood is prevented flowing by the external orifice and passes into the cellular substance

forming ecchymosis. When the effused blood rises into a tumor, which is sometimes the case, it is called Thrombus. Ecchymosis and Thrombus, therefore, are only different degrees of the same affection, and are in general productive of no worse consequences than the stoppage of the flow of blood, although, when the effusion is extensive, it may terminate in suppuration. Ecchymosis occurs most frequently from opening those veins which lie loose in the cellular substance, as the cephalic; and, in order to prevent its occurrence, the surgeon should be careful not to change the position of the arm while the blood is flowing. If he has unwarily done so, and the blood begins to pass into the cellular substance, he should immediately endeavour to bring the arm back to the position in which it was when the lancet was introduced. If he is unable to effect this, he should at once remove the ligature, as its presence will increase the effusion; and if it is necessary to abstract more blood, he must open a vein in the other arm.

Ecchymosis is most readily removed by the application of cloths wet with the aqua ammoniæ acet. the spiritus vin. camphor. or with spirits and vinegar. If the tumor becomes hard and inflamed, a poultice must be applied, and if it terminates in suppuration, it must be opened, and the contents discharged.

2d. INFLAMMATION OF THE SKIN AND SUBJACENT CELLULAR SUBSTANCE.—Inflammation of the skin and subjacent cellular substance, after the operation of venesection in the arm, is by no means a rare occurrence. If the lips of the wound have not been placed in accurate contact, and a compress has been carelessly applied, the orifice is fretted, it becomes inflamed, and the inflammation assumes a form more or less alarming according to the state of the patient's constitution, and the circumstances in which he may be placed. Thus, if the constitution is healthy, and the patient is not exposed to febrile contagion, the inflammation will be phlegmonic and circumscribed; but if the patient has led an intemperate life, if his system is unhealthy, or if he is in an hospital where erysipelas is prevailing, the inflammation will be of the erysipelatous kind, and diffused, or it may partake of the nature of both, according to circumstances. When the inflammation is phlegmonic, it is never attended with danger; when of the erysipelatous character, it is frequently not only very extensive, but from being liable to terminate in suppuration and gangrene, may involve the life of the patient. In one case which occurred in the Royal Infirmary of Edinburgh, the erysipelas spread over all the inner part of the arm, and extended to the top of the shoulder and fore part of the chest, attended with great constitutional derangement. The patient died, and upon dissection, I found the cellu-

lar substance along the inner part of the arm, and particularly in the course of the basilic vein, full of pus, and the biceps, pectoralis major and minor muscles, with the anterior part of the deltoid in a state of gangrene; but the vein was not affected, its cavity was uninflamed, and there was no thickening nor hardness of its coats.

When the inflammation is of the phlegmonic kind, the patient must be briskly purged, and cold saturnine solutions should be applied to the part; but if it threatens to terminate in suppuration, warm fomentations and emollient poultices are the best applications. On the contrary, if the inflammation is erysipelatous, cathartics, emetics, and antimonials with opiates, should be exhibited, and the inflamed parts fomented with warm saturnine and opiate solutions.

3d, Inflammation of the absorbents.—Inflammation of the absorbents following bleeding, is a very rare occurrence; but when the external orifice inflames and tumefies, and the inflammation extends to the adjoining skin and cellular substance, these vessels sometimes become involved. The absorbents are very susceptible of inflammation, and when they are attacked with it, the affection spreads rapidly along their inner surfaces, both upwards and downwards. They can then be traced in the form of small hard cords under the skin, which are very painful when

pressed upon, and the absorbent glands, both in the arm and forearm, generally inflame, swell, and sometimes suppurate. This is particularly the case with the axillary glands. The inflammation is in general not confined to one absorbent, but extends to the neighbouring vessels, and on these occasions, the whole arm swells, and is extremely painful, particularly on motion, and there is great symptomatic fever.

The inflammation is sometimes effectually subdued by cold saturnine lotions; but I believe the preferable practice to consist in fomenting the arm three or four times a day with warm solutions of opium and the acetate of lead, applying in the intervals, warm saturnine poultices, at the same time keeping the arm at rest, and administering saline cathartics.

4th. Inflammation of the vein.—When the external orifice alone inflames, and the lips of the wound separate, the inflammation sometimes extends to the skin and subjacent cellular substance, or to the absorbents; but, when the opening in the vein does not adhere, but inflames, the inflammation is apt to spread along the internal surface of the vessel, producing a train of most alarming symptoms, and endangering the life of the patient. Mr. Hunter was the first who suggested that the inflammation of the vein sometimes followed the operation of bloodletting, and

on some occasions proved fatal.* He had frequently observed, that when horses in perfect health were bled in the neck, it swelled, and the animals died; and, upon examination, he found that the vein had inflamed and suppurated, and that the inflammation extended to the heart. Since the inflammation of the orifice was amongst the first symptoms of this disease, Mr. Hunter concluded that the inflammation was within the cavity of the vein, and that it was sometimes arrested in its progress by the sides of the vessel adhering; but, that when death followed, it arose either from the inflammation extending along the vessel to the heart, or from the purulent matter formed in consequence of it passing into the circulation.

The inflammation of the vein may be very extensive, running downwards and upwards, and even reaching to the heart; or it may involve only a small portion of the vessel in the immediate vicinity of the wound. When it is extensive, the accompanying symptoms are very alarming, and the constitutional derangement is so great, that the patient generally dies. The arm inflames and swells, and the vein in its course feels hard, and is very tender to the touch; there is great quickness of pulse, with furred tongue, delirium, hurried respiration, and vomiting; and

* See a paper by Mr. Hunter, in the Medical and Chirurgical transactions, vol. 1st.

the patient complains of violent pain under the sternum, and in the epigastric region. Upon dissection, the inner surface of the vein is found to be of a deep claret colour, generally coated with coagulating lymph, and containing purulent matter. It is thickened in its coats, the adjoining cellular substance is in a state of suppuration, and the neighbouring muscles are not unfrequently gangrenous. When the inflammation is more circumscribed, the symptoms are less violent; but there are still considerable fever, foul tongue, and derangement of the intellectual functions, with inflammation and swelling of the arm, hardness of the vein, and great pain when pressed on.

In the treatment of inflammation of a vein, more especially if he has been called early, the surgeon should close the channel of the vein by compression, both immediately above and below the wound. The sides of the vessel being laid together, adhere; and thus the vein degenerates into a firm cord. It seems to be by this process of adhesion, that the inflammation in the vein is arrested, when it ceases of its own accord. Besides the application of the compress, the general inflammation of the arm must be allayed by saturnine and opiate fomentations, saturnine poultices and leeches, with saline cathartics; and, on some occasions, it may be necessary even to open a vein in the other arm.

5th. INFLAMMATION OF THE FASCIA.—When the vein has been transfixed, and the fascia punctured, the latter is apt to inflame, and is then followed by the train of symptoms which characterize punctured wounds in other situations where the parts are bound down by a fascia, such as great pain, tension, contraction of the limb, and sympathetic spasms of the whole body. When the fascia inflames, it thickens, there is a sensation as if the arm was bound down with a cord, the fingers are contracted, the elbow joint becomes bent, the patient is unable to extend the arm, and, when the surgeon attempts to extend it, there is great pain. On the inflammation subsiding, the patient in general gradually recovers the free use of the limb; but this is not always the case, as sometimes in consequence of the thickening of the inflamed parts, the fingers remain bent, and the fore-arm becomes permanently contracted.

In the treatment of inflamed fascia, we have recourse to the means already recommended for inflammation of the other structures of the arm, arising from blood-letting; but if there be much tension and contraction, and more especially if the constitutional symptoms are severe, the fascia should be freely divided in a transverse direction. This is safely and effectually done by commencing an incision upon the inner side of the artery, near the inner condyle of the humerus, and carrying it several inches in an oblique direction down the arm and through the fascia. This incision may

be made, either during the inflamed state of the fascia, in order to relieve urgent symptoms, or after the inflammation has subsided, for the purpose of removing permanent contraction of the limb.

There are two cases detailed in the second volume of the Medical Communications, by Mr. Watson, late surgeon of the Westminster Hospital, which illustrate well this inflammation, thickening, and tension of the fascia, with contraction of the fingers, in consequence of bleeding. The patients were cured by free incisions, which cut the fascia across, and relieved the tension arising from the muscles of the arm.

6th. Wound of a Nerve.—From the manner in which the branches of the internal and external cutaneous nerves are connected with the superficial veins of the arm, it is evident that they must frequently be wounded in blood-letting. Some writers, even of celebrity, ascribe the wounding of the nerves to the surgeon having transfixed the vein; but it is erroneous to imagine, that the nerves in all cases run behind the veins, or that they can be wounded only by carrying the lancet through these vessels. We have already remarked, that the branches of the internal and external cutaneous nerves frequently pass over the veins, or run along their fore-part; it is obvious, therefore, that as these are wounded before the lancet

enters the vein, no blame is imputable to the operator, and that the accident may happen in the hands of the best surgeons.

When a nerve is wounded, the patient screams upon the introduction of the lancet; but if the nerve does not inflame, no bad consequences ensue. There seem to be two states under which the inflammation of the nerve appears. It may inflame either along with the skin, the cellular substance, and the other parts with which it is in immediate contact, or by itself, independently of the other structures. In the first of these cases, which I believe to be the most common, the inflammation commences first in the external orifice, the lips of which swell and separate; but, in the second case, the external wound at once adheres and continues uninflamed. When the nerve inflames, it is at the distance of some days from the time it was wounded, and the inflammation is attended with great pain shooting up the arm, along the neck, to the head, and down to the fingers. Then follow convulsive twitches of the arm, productive of restless nights and frightful dreams. In the progress of the disease, the tetanic symptoms are more strongly marked, spasms extend to the back, the jaw becomes locked, and then the patient generally dies.

In the treatment of inflamed nerve, independently of the common local means used for inflammation, such as warm fomentations, saturnine lotions, &c. the surgeon should divide the nerve,

as practised successfully and recommended by Scultetus. This may be safely and effectually done by making a short transverse incision immediately above the wound, and carrying it down to the fascia of the muscles. The only parts involved in this incision will be the vein and the injured nerve, with its adjoining filaments. This operation should on all occasions be had recourse to as soon as the surgeon ascertains that the nerve is wounded, there being every reason to believe, that, when the tetanus has become general, the division of the nerve will not be attended with success.

END OF VOLUME SECOND.